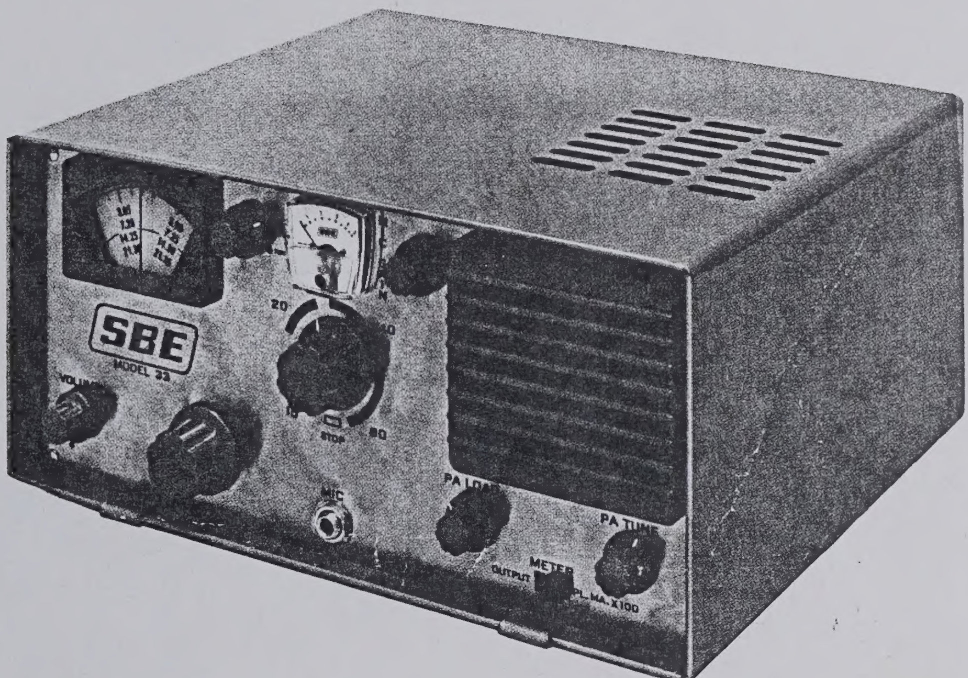
SBE SIDEBAND ENGINEERS, INC.
RANCHO SANTA FE, CALIFORNIA



OPERATION and SERVICE

SB 33 SINGLE SIDEBAND TRANSCEIVER

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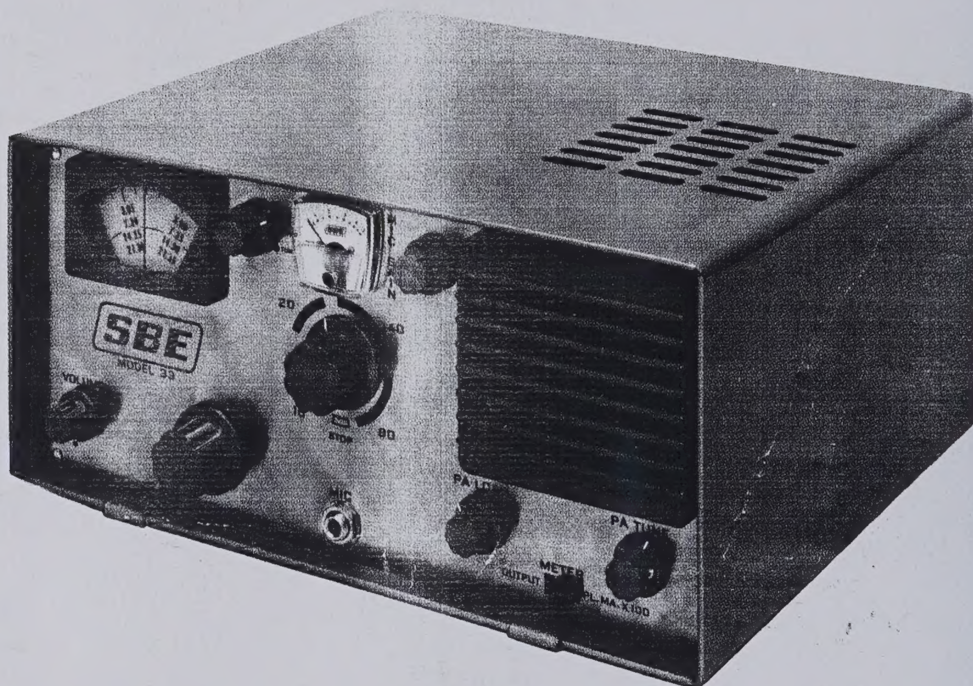

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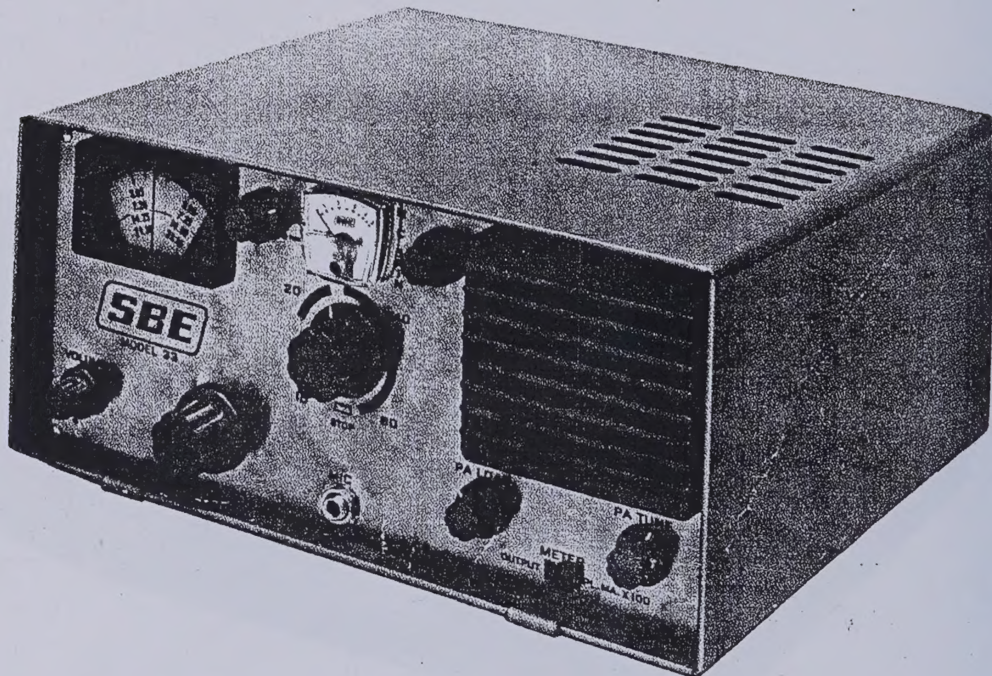

OPERATION and SERVICE

SB 33 SINGLE SIDEBAND TRANSCEIVER

GENERAL DESCRIPTION

Sideband Engineers Inc. Model 33, is a single sideband, suppressed carrier transceiver designed specifically for use on the phone portions of the 80-, 40-, 20-, and 15-meter amateur radio bands. Operation may be either upper or lower sideband, selection being made through a front-panel control. Transmission is on the exact carrier frequency being received, and there is no carrier shift in changing from upper to lower sideband operation. Peak effective power output exceeds 70 watts on 80-, 40-, and 20-meters, and 50 watts on 15-meters.

The transceiver is self-contained-only a microphone and an antenna are required for operation from a nominal 117-volt a-c power source. Operation is possible from a mobile or portable source through use of a transistorized d-c to a-c inverter which is available as an accessory. Provisions have been made for the addition of a VOX-audio compression unit which is also available as an accessory.

Basic circuitry of the SB-33 is solid-state. Transistors are utilized in all low-level stages, vacuum tubes are used in only the transmitter driver and power amplifier stages. The use of bilateral amplifier and mixer stages which amplify in one direction in transmit and in the other direction in receive, permits use of a single bandpass circuit train. Duplication of circuitry is eliminated, and performance is optimized through use of common circuit elements in both the receive and transmit modes.

A unique bandswitching and exciter tuning control allows both functions through a single front-panel control knob. Other controls and adjustments are held to a minimum. Stability and selectivity are exceptionally high. The design is such that the few heat producing components are isolated from the frequency determining elements. All voltages to the low-level stages are regulated and the VFO is temperature compensated. Selectivity of 2.1 kc at 6 db is achieved on both transmit and receive through use of a COLLINS mechanical filter.

The entire one-package installation is less than one-half cubic foot, weighs approximately 15 pounds, and is entirely self-contained, including power supply and speaker. Because of the revolutionary new circuitry, (patents pending), and unique design, you have the smallest, best performing SSB transceiver available today at any price.

SPECIFICATIONS

TYPE OF EMISSION	Single sideband, suppressed carrier, upper or lower sideband selectable from front panel.
FREQUENCY RANGE	3.8 to 4.0 mc, 7.15 to 7.35 mc, 14.2 to 14.4 mc, 21.25 to 21.45 mc.
POWER CONSUMPTION	Receive 35 watts, Transmit 165 watts (single tone transmit)
POWER OUTPUT	80, 40, 20-meters, 70 watts, min., 15 meters 50 watts, min.
CARRIER SUPPRESSION	50 db
UNWANTED SIDEBAND SUPPRESSION	40 db
DISTORTION PRODUCTS	Down at least 25 db
SPURIOUS RESPONSE	Down at least 40 db
ANTENNA OUTPUT IMPEDANCE	40 to 100 ohms, unbalanced. VSWR not to exceed 2:1
SENSITIVITY	Less than 1 microvolt for 10 db signal-to-noise ratio.
SELECTIVITY	2.1 kc at 6 db down, 4.5 kc at 60 db down, both transmit and receive.
AUDIO OUTPUT	2.0 watts at 10 percent distortion, 3 watts max.
DIMENSIONS	5½ in. high, 11¾ in. wide, 10¼ in. deep.
WEIGHT	Approximately 15 pounds.

WARRANTY

Sideband Engineers Inc. warrants this equipment against defects in materials and workmanship, except for tubes and transistors, under normal service for a period of ninety days from date of purchase. This warranty is limited to repairing or replacing the defective parts and is not valid if the equipment has been tampered with, misused, or damaged. Do not forward equipment for warranty service without prior written authorization from factory. Return equipment for warranty service to:

Sideband Engineers Repair Dept.
143 South Cedros, Solana Beach, Calif.

For Service Call SK 5-4133
Area Code 714

INSTALLATION

The SB-33 Transceiver has been designed to provide a complete single package installation that is suitable for use in fixed, portable, and mobile installations. No special precautions need be observed in the choice of location, as long as adequate ventilation space is provided. A minimum of two inches of air space above the cabinet top, and on all sides, is recommended to allow proper ventilation through the slots on the top and bottom of the cabinet. Do not put the unit on a car seat or any other similar surface which will block ventilation through the bottom.

POWER

A 117-volt ac power cord is furnished with the transceiver. All connections for a-c operation are made by plugging it into the receptable on the rear panel of the unit. The white ground lead that is supplied as part of the power cord should be connected to a good ground, such as a water pipe. This is not necessarily an RF ground, but is only an a-c ground. The power plug must be properly polarized when it is plugged into the power outlet. A small neon lamp is mounted on the rear panel to indicate proper polarity. With the ground lead connected to a suitable ground, and the transceiver turned OFF, insert the power plug into the outlet. If the neon lamp glows, reverse the plug in the outlet. No damage to the set will result if the plug is incorrectly polarized, but some hum modulation is likely to appear on the transmitted signal.

ANTENNA

Results both in receiving and transmitting with the transceiver will depend largely on the antenna used. The receive mode is particularly sensitive to the antenna used. Any of the common antenna systems designed for use on the high frequency amateur bands may be used with the SB-33 Transceiver, provided the input impedance of the antenna system is within the capability of the pi-output matching network, (40 to 100 ohms, resistive). Any antenna system which meets these requirements will provide satisfactory results. If tuned open-wire transmission line is used, or if a long wire antenna is desired, a suitable antenna tuner should be used between the unit and the antenna to provide an impedance match between the unbalanced coaxial output and the balanced open-wire line or long wire. For mobile operation, the antenna should be mounted so that the effects of detuning from changes in the relation of the car body and antenna are minimized.

LINEAR AMPLIFIER

The SB-33 Transceiver may be operated in conjunction with any conventional linear amplifier. A 10-volt keying voltage is provided on pin 7 of the power receptacle for controlling the linear amplifier. If the control relays in the amplifier are not designed to operate from such a voltage, an intervening relay will be needed to adapt the particular amplifier used. Any 12-volt d-c relay may be used, provided that the coil resistance is 75 ohms or less. If in doubt as to the suitability of the amplifier to be used, contact Sideband Engineers Inc., enclosing the schematic diagram of the amplifier to be used.

MOBILE OPERATION

Operation of the transceiver from a 12-volt d-c battery source is possible through a special transistorized d-c to a-c inverter which is available as an accessory. A locking-type mobile mounting base is also available. Operation from a conventional vibrator inverter is possible, but will result in lowered transmitter output since the high voltage supply in the transceiver will not respond correctly to the square-wave voltage output these inverters deliver.

Any of the commercially available mobile antennas may be used with the SB-33 transceiver. Results on bands other than that to which the antenna is tuned will be poor. It is essential that the particular antenna be resonant on the band used.

OPERATION

Note

The SB-33 transceiver has been specifically designed to provide the utmost ease of operation, and all panel controls have been thoroughly checked before shipment from the factory. Several of the front-panel controls are unusual in operation, however, and improper adjustment may result in signals of poor quality, and even out-of band operation. Read this section carefully before attempting to operate the transceiver.

CONTROL FUNCTIONS

The various front-panel controls, and their functions, are described in detail in the following paragraphs. Make certain that you understand the function of each control before attempting to operate the transceiver. Detailed instructions are given for tuning the transmitter. The design of the unit is such that when the transmitter is properly tuned, the receiving portion of the unit is also properly aligned to the frequency being used.

VOLUME CONTROL. The power ON/OFF and volume control (RF gain) functions are combined on a single control knob located at the lower left corner of the front panel. Operating the knob clockwise beyond the click turns the unit on. With mobile installations, this control turns the inverter on. Volume in receive is set to the desired level by turning the knob further clockwise. Since the receiver is fully transistorized, no warm-up period is required.

TUNING KNOB. The large knob directly to the right of the volume control knob controls the VFO tuning, and sets the exact frequency of receiving and transmitting simultaneously within the selected band. The various fre- [illegible]

the normal sense. The SB-33 will, however, provide good communications under conditions of high noise and weak signals when conventional receivers with extended audio range and wide bandpass are completely unusable.

Every effort has been made to prevent the receiver from overloading or blocking on strong signals. Since the volume control affects only the RF section of the receiver, rather than the customary audio circuits, the receiver is *less likely to overload at low volume settings than at high settings.* Quite often interference from close-by stations can be completely eliminated by merely reducing the volume control setting. A limited action automatic gain control system (AGC) is incorporated in the transceiver. It provides strong compression on signals when the audio output exceeds approximately one-quarter watt. Its primary purpose is to eliminate the "flutter" when operating mobile, but will also be very useful for "roundtables" where received signal strengths may vary greatly.

SPURIOUS SIGNALS. A few spurious responses or "birdies", may be noted as the receiver is tuned through the various bands. With a normal antenna, and in an average location, all of these responses will be below the level of a readable signal, with the possible exception of a single response at 7300.8 kc. Since this response is outside the amateur bands, it should cause no inconvenience to the operator. It is, in fact, useful as a means of checking the dial accuracy, since it has the stability of the carrier oscillator, and may be relied upon to be accurate as a frequency marker.

TRANSMITTER TUNEUP

Note

Improper transmitter tuning can result in serious [illegible] even out-of-band op-

simultaneously within the selected band. The various frequencies with the band ranges are cali[illegible] on the dial above the tuning knob. Tuning single sideband signals requires careful adjustment of the tuning control. If no adjustment of the tuning knob will permit intelligent reception of a single sideband signal, it is quite likely that the station is transmitting on the sideband other than the set is adjusted for. See MODE SELECTOR, below.

MICROPHONE CONNECTOR. The MIC. jack is located directly to the right of the tuning knob, and accepts a standard PL-68 microphone plug. The microphone should be connected to the ring, and the push-to-talk switch connected to the tip. The SB-33 transceiver is designed to operate with a medium-to-high impedance dynamic microphone, such as the Turner Model SR90D, or equivalent. Crystal or ceramic microphones will give poor results, unless an auxiliary preamplifier is used, because of the mismatch between the exceptionally high impedance microphone and the low impedance transistor microphone amplifier. Carbon microphones also will operate only if external provisions are made for their use.

BANDSWITCH. The bandswitching and exciter tuning functions are combined in a single knob located just below the meter. With the knob indication fully clockwise, the transceiver is set on 80 meters, and the front end of the receiver is peaked by rotating the knob through the arc labeled "80". Correct setting is indicated by a sharp rise in background noise similar to that obtained with the "antenna tuning" control on a conventional receiver. To change to 40 meters, the knob is rotated counter-clockwise beyond the 80-meter arc. A click will be heard between the 80- and 40-meter arcs. This is the bandswitch operating to the 40-meter position. Tuning is again performed by rotating the knob through the 40-meter arc, and is indicated by a sharp rise in noise. This is progressively repeated for operation on the 20-, and 15-meter bands. A stop is provided at the extreme counter-clockwise rotation past the 15-meter arc. Do not attempt to rotate the knob past this stop. No damage will result, but the knob may slip and cause loss of calibration. If this should happen, turn the bandswitch knob fully clockwise, loosen the knob setscrew, and set the knob index exactly on the clockwise stop mark on the panel. Tighten the setscrew securely. Further adjustment of the bandswitch knob is covered in the TRANSMITTER TUNEUP section.

MODE SELECTOR. Just to the left of the meter is the Mode Selector knob. With the knob set on LSB, the transceiver is adjusted to receive and transmit a lower sideband signal. Upper sideband operation is selected by moving the knob to USB. In the TUNE position, the transceiver is placed in the transmit condition, and sufficient carrier is inserted to allow tuning of the final amplifier stages. The majority of single sideband operation on 80 and 40 meters is lower sideband, and practically all 20- and 15-meter operation is upper sideband. If operation is on one sideband, and it is desired to change to the other sideband, no change in tuning is required.

TRANSMITTER CONTROLS. The controls used exclusively in transmitting are clearly labelled on the panel, MIC. GAIN, PA TUNE, PA LOAD, METER SWITCH. Their function is described in the TRANSMITTER TUNING section.

RECEIVER OPERATION

The SB-33 transceiver employs a 2.1 kc COLLINS mechanical filter to attain exceptional selectivity on both receive and transmit. The unit is designed to pass only that portion of the voice spectrum falling between 300 and 2400 cycles. Experience has shown that this bandwidth permits excellent intelligibility and still discriminates against interfering noise. Since the transceiver audio system and speaker is also carefully shaped to pass only 300 to 2400 cycles, the end result is reception similar to the quality of a conventional telephone. No setting of the transceiver will produce "high fidelity" reception in

Improper transmitter tuning can result in interf[illegible] even out-of-band operation. Improper adjustment of the Mic. Gain can result in "flat-topping" and the generation of splatter and other spurious emission. [illegible]ke certain you understand the following instructions thoroughly before you attempt to operate the transmitter.

Transmitter tuneup consists of adjusting the exciter, loading the power amplifier to the antenna, and setting the microphone gain control for optimum results. The SB-33 Transceiver has been carefully designed to minimize the possibility of improper operation due to faulty tuning procedures, and to make the tuneup procedure as simple and quick as possible. The combination bandswitch and exciter tuning, for instance, has been designed to preclude the possibility of tuneup on incorrect frequencies. It is, however, possible to transmit a poor signal if the set is not correctly tuned. Take the time to memorize the following step-by-step procedure, and your SB-33 Transceiver will always transmit a clean, powerful signal that will be a credit to your station.

EXCITER TUNING. With the transceiver turned on, allow 30 seconds for warmup of the transmitter driver and power amplifier stages. Set the bandswitch to the desired band, *making certain that an antenna resonant to that band is connected.* Set the bandswitch knob for maximum noise, as outlined in previous instructions. Set the MIC. GAIN, PA LOAD, and PA TUNE controls full counter-clockwise, and the METER switch in PL. MA. X 100 position. Now turn the mode selector switch to TUNE position. The receiver will be quiet, and some indication will appear on the meter. Carefully adjust the bandswitch knob for maximum meter indication. This will occur at a setting very close to that which produced maximum receiver noise. One or more peaks may be evident if the bandswitch knob is tuned through the entire arc, but the correct setting will always be near the point of maximum receiver noise, and will always produce a much higher meter reading. The exciter is now tuned.

POWER AMPLIFIER TUNING. Turn the PA TUNE control clockwise until a sharp dip in meter indication occurs. At this point, switch the meter to OUTPUT position. Some meter indication will be evident. Turn the PA LOAD control clockwise to the point that produces maximum meter indication. Then readjust the PA TUNE control for maximum meter indication. Repeat alternating adjustment of PA TUNE and PA LOAD controls until the meter reads maximum possible, with final adjustment made of the PA TUNE control. This completes the exciter and power amplifier tuneup.

MICROPHONE GAIN ADJUSTMENT. Turn METER switch to PL. MA. X 100, and mode selector to TUNE long enough to note meter reading. With the transceiver properly tuned to a resonant antenna, the reading should be between 2.0 and 2.5. Return the mode selector to the desired sideband, and press the microphone button and speak a steady "AHHH" into the microphone at the level and distance you intend to use when transmitting. Gradually turn the MIC. GAIN control clockwise until the meter reading increases to approximately 1.5 if the maximum reading was 2.5, or 1.3 if the maximum reading was 2.0. This setting of the MIC. GAIN control will ensure a strong transmitted signal without danger of overdriving.

Note

It is very important that the MIC. GAIN control be correctly set. If it is too high, voice peaks will overdrive the power amplifier to a non-linear condition, resulting in flat-topping. Exact setting will depend onthe microphone used, and how close and loud the operator speaks. It may be possible to increase the setting of the MIC. GAIN control while another station checks your signal, but such on-the-air reports are subject to many inaccuracies.

... key marker.

TUNING KNOB. The large knob directly to the right of the volume control knob controls the VFO tuning, and sets the exact frequency of receiving and transmitting simultaneously within the selected band. The various frequencies with the band ranges are calibrated [illegible] above the tuning knob. Tuning single sideband signals requires careful adjustment of the tuning control. If no adjustment of the tuning knob will permit intelligent reception of a single sideband signal, it is quite likely that the station is transmitting on the sideband other than the set is adjusted for. See MODE SELECTOR, below.

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TRANSMITTER TUNEUP

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POWER AMPLIFIER TUNING. Turn the PA TUNE control clockwise until a sharp dip in meter indication occurs. At this point, switch the meter to OUTPUT position. Some meter indication will be evident. Turn the PA LOAD control clockwise to the point that produces maximum meter indication. Then readjust the PA TUNE control for maximum meter indication. Repeat alternating adjustment of PA TUNE and PA LOAD controls until the meter reads maximum possible, with final adjustment made of the PA TUNE control. This completes the exciter and power amplifier tuneup.

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THEORY OF OPERATION

The SB-33 single sideband transceiver is essentially bilateral. With the exception of the receiver RF Amplifier and the high-level transmitting stages, the signal stages may amplify in either direction. During the receive function they amplify in one direction, on transmit they amplify in the opposite direction. The same tuned circuits are used for both transmitting or receiving. The various injection oscillators operate continuously, supplying the local oscillator signals to the proper mixer stages.

All transistors in the transceiver operate in the common emitter configuration, with the exception of the Receiver RF Amplifier, Q12. This stage operates common base. (See Schematic on reverse side).

A typical bilateral amplifier stage may be understood by referring to the 456 KC Amplifier, Q6 and Q7, in the schematic diagram. With relay K1 de-energized, or in receive position, the 33K base bias resistor of Q6 is returned through the relay contacts to the 10-volt bus. Since the emitter of Q6 is also connected to 10 volts, no base current flows, and the transistor remains cut off. The 18 K base bias resistor of Q7 is returned through the volume control and relay contacts to ground. With the volume control advanced, Q7 conducts and amplifies any signal appearing on its base. Thus, with the relay de-energized, this stage will amplify a signal appearing at the mechanical filter, FL-1, and the amplified output will be impressed on the i-f transformer T1. With the relay energized, or in transmit position, the reverse occurs, and Q6 conducts while Q7 is cut off. A signal appearing at T1 will be amplified and fed to filter FL-1. Similarly, the amplifying direction of the VFO Mixer, Q8 and Q9, and the High Frequency Mixer Q10 and Q11, is controlled by the relay. Unilateral stages that are required to operate only on receive or transmit are turned off when not in use by returning their base bias resistors to the appropriate relay contact. The transmitter tubes are disabled during receive by opening their cathode leads.

TRANSMIT FUNCTION

An audio signal from the microphone, controlled in amplitude by the MIC. GAIN control, is amplified by the Microphone Amplifier, Q4, and applied to the base of the Signal Splitter, Q5, which acts as an emitter follower. The low-impedance output from Q5 drives a ring balanced modulator, CR1-4. Crystal Oscillator, Q14, operating at 456.45 kc, provides a carrier to the balanced modulator through Emitter Follower, Q13. Carrier balance is obtained by a potentiometer and a trimmer capacitor. Double sideband, suppressed carrier output from the balanced modulator is amplified through T1 by the bilateral 456 KC Amplifier, Q6 and Q7. The amplified signal is then passed through Mechanical Filter FL-1 which suppresses the upper sideband.

Output from Crystal Oscillator, Q14, is also applied to Frequency Doubler Q15. The doubled frequency from Q15 is then either doubled again or tripledby Q16. With the mode selector switch set to LSB, the frequency is doubled, with the switch on USB, it is tripled. Thus, on LSB a 1825.8 kc (456.45 X 4) signal appears on lug E of T6. On USB, a 2738.7 kc (456.45 X 6) output appears.

Doubler/tripler transformer T6 is connected in a ring with filter FL-1, Sideband Selector Mixer CR5, and transformer T2, which is tuned to 2282.25 kc, to form a ring mixer. With the mode selector on LSB, 1825.8 kc output from T6 is additively mixed with the filter output, 456.45 kc, to produce a 2282.25 kc lower sideband signal at T2. With the mode selector set on USB, the 2738.7 kc output from T6 is subtractively mixed with the filter output to produce a 2282.25 kc upper sideband signal at T2. Thus, the mode selector determines the mode of the sideband signal by setting the Doubler/Tripler, Q16, to either double or triple the second harmonic of the carrier oscil- Q11, the final output frequency, appears across coil L2. The resonant frequency of L2 is controlled both by a large variable capacitor and a special slug which penetrates the coil by an amount dependent upon the setting of the bandswitch. The large variable capacitor is mechanically linked to the bandswitch through a Geneva movement (Patent Applied for) so that rotating the variable capacitor shaft tunes the coil through a limited range, bracketing the given operating band, then changes the bandswitch to the next band, tuning a limited range bracketing this band, etc. On 80 meters the slug is almost fully penetrated into the coil, and the variable capacitor is near maximum capacity. On 40 and 20 meters, the slug and capacitor are at near mid-range, and on 15 meters, the slug is fully withdrawn from the coil and the capacitor is near minimum. In this unique method of tuning and bandswitching, the Q and inductance/capacitance ratio of L2 and the variable capacitor are near optimum on all bands, and the resonant impedance remains essentially constant across the tuning range. This tuning is linked with, and duplicated in, antenna coil L3 and driver coil L6, to result in exciter train tuning with only one control.

The single sideband, suppressed carrier final output signal from L2 is applied to the grid of Transmitter Driver V1, where it is amplified, and appears across L6. A low-impedance winding on L6 couples the signal to the parallel grids of Power Amplifiers V2 and V3. Neutralization of the power amplifiers is accomplished by feeding back a small amount of the output through Cn to the top of L6, with the low impedance winding providing the necessary phase reversal.

Final output from V2 and V3 is fed to a pi-section network consisting of L7 and the PA TUNE and PA LOAD capacitors. A section of the bandswitch adjusts the inductance of L7 to the correct value for each band, and also adds fixed amounts of capacity to both the PA LOAD and PA TUNE capacitors on 80 meters.

RECEIVE FUNCTION

With relay K1 de-energized, a signal from the antenna is coupled through a low-impedance tap to antenna coil L3. Diode CR6 is essentially paralleled across the coil and conducts only when extremely strong signals are present, thus protecting the Receiver RF Amplifier Q12 from the possibility of burning out. On transmit, diode CR6 is forward biased, effectively shorting L3 at all times.

The signal at L3 is coupled to the emitter of Receiver RF Amplifier Q12, which operates as a common-base amplifier. The gain of the stage is controlled by AGC Amplifier Q19. A measured amount of the audio output signal is rectified by Q19 and used to bias the emitter of Q12 toward cutoff. Q12 operates at full gain on very weak signals, but cuts off in the presence of even a moderate signal, thus protecting the following stages from overload.

The amplified signal from Q12 is applied to bilateral High Frequency Mixer Q10 and Q11. With injection from Q3, this stage converts the signal to a frequency within the range 3225 to 3425 kc. The converted signal is then mixed by Q8 and Q9 to 2282.25 kc with injection received from VFO Q18 and VFO Buffer Q17.

Output from VFO Mixer Q8 and Q9 is converted by diode CR5 to the 456.45 kc reference frequency in a manner exactly opposite to that described for this stage during the transmit function. The filter output from FL-1 is then amplified by Q6 and Q7 and coupled through T1 to the ring modulator, CR1-4.

With BFO injection from the carrier oscillator, the ring modulator now functions as a detector, and produces an audio output which is applied to the emitter of Signal Splitter Q5. On receive, Q5 operates as a common-base amplifier, with output taken from the collector and ap-

double or triple the second harmonic of the carrier oscillator. When the mode selector is in TUNE position, operation is USB, and a measured amount of carrier signal is inserted in the d-c load resistor of CR5, for tuneup.

The 2282.25 kc upper or lower sideband output from T2 is applied to the bilateral VFO Mixer, Q8 and Q9. Also applied to this mixer is an injection signal between 5507.25 kc and 5707.25 kc. The frequency of this injection is controlled by the main tuning knob, and determines the final output frequency within the selected band. This frequency is generated by the VFO, Q18, and amplified by VFO Buffer Q17. Buffer coil L4 broadly tunes the buffer to provide constant output across the VFO range.

Tunable i-f transformer T3, connected to the output of VFO Mixer Q8 and Q9, tunes the frequency range 3225 kc through 3425 kc. This frequency range is the result of mixing the incoming 2282.25 kc sideband signal with the VFO injection frequency, and can be either upper or lower sideband, depending on the mode selected. Transformer T3 is gang-tuned with the VFO, and thus is always accurately tuned to the desired frequency.

The 3225 kc to 3425 kc sideband signal output from VFO Mixer Q8 and Q9 is applied to the bilateral High Frequency Mixer, Q10 and Q11. Also applied to this mixer is an injection frequency from the High Frequency Crystal Oscillator, Q3. On 80 meters, this oscillator produces output at 7225 kc, controlled by crystal Y2. On 40, 20, and 15 meters, Q3 is connected as an overtone oscillator, with the overtone frequency being determined by the resonant frequency of L1 and the trimmer capacitor switched in by the bandswitch. Crystal Y3, with a fundamental frequency of 3525 kc, operates on its third overtone on 40 meters, (10,575 kc), on its fifth overtone on 20 meters, (17,625 kc) and on its seventh overtone on 15 meters, (24,675 kc). The 3225 to 3425 kc single sideband signal is subtractively mixed with the injection frequency on all bands, resulting in consistent dial readings and sideband selection. The output of High Frequency Mixer Q10 and amplifier, with output taken from the collector and ap- -plied thru Driver Q1. Output is then passed through transformer T7 to Audio Power Amplifier Q2, and then to the speaker through T8.

The VOLUME (RF gain) control sets the gain, on receive only, of the bilateral High Frequency Mixer and 456 KC Amplifier. VFO Mixer Q8 and Q9, and the audio stages, operate at full gain at all times.

POWER SUPPLY

High voltage of approximately 480 volts is furnished to the transmitter driver and power amplifier stages by a voltage tripler, CR-11, CR-12, and CR-13, operating directly from the incoming 117-volt a-c line. Since all parts of the driver and power amplifier stages are electrically isolated from the chassis, no shock hazard exists. However, due to the voltage gradient existing between the voltage tripler and chassis ground, it is necessary to properly polarize the power plug. A neon lamp facilitates proper connection of the plug to the a-c power outlet. As explained in the Installation section, the neon light must be out to indicate proper polarization.

A two-winding transformer supplies the remaining voltages required by the transceiver. One winding operates the series-connected heaters of the driver and power amplifier stages, and in addition is full-wave rectified by diodes CR-8 and CR-9. The filtered output of this winding is approximately 15 volts, and supplies power for the Audio Output Amplifier Q2. In addition, this voltage is series regulated by Q20 and zener diode CR-14 to provide regulated 10-volt output to all other transistor stages except Q1, Q4, Q5, and Q13, which require additional filtering. The voltage for these stages is smoothed by a resistor-capacitor filter operating from the 10-volt bus, and is 9.5 volts.

Bias for the transmitter power amplifier is obtained from the second winding of the transformer, and is rectified by CR-10. The actual value of bias voltage is determined by the bias-adjust potentiometer.

TROUBLESHOOTING

The SB-33 transceiver has been carefully aligned and tested at the factory, and all adjustments that might become misaligned from the effects of vibration and temperature cycling have been securely locked in place.

Problems that might possibly arise, and their detection and correction, are included in the following paragraphs.

CARRIER BALANCE

The SB-33 transceiver is designed to maintain carrier suppression of at least 50 db below full output for extended periods of time. If for any reason excessive carrier is present, the carrier balance potentiometer on the rear panel should be readjusted. The most accurate method for doing this requires a fairly sensitive vacuum-tube r-f voltmeter, such as the Hewlett-Packard HP-410B, or equivalent, connected across the antenna terminals. With the MIC. GAIN control set fully counter-clockwise, and the microphone button pressed, the residual carrier, as measured by the voltmeter, should be nulled to a value of 0.2 volts rms, or less, by use of the carrier balance potentiometer. Check operation on both sidebands since there may be a slight variation in carrier between the two modes. Any variation should be averaged out by the potentiometer. If it is not possible to reduce the carrier to a reading of 0.2 volts with the potentiometer alone, remove the set from the cabinet, and readjust the carrier balance capacitor located on the chassis top near the rear left corner of the chassis. This capacitor and the potentiometer interact somewhat so that several cycles of adjustment may be required.

LOW TRANSMITTER OUTPUT

Loss of transmitter output generally indicates weak tubes. If the off-resonance plate current of the power amplifier stage becomes somewhat less than 250 ma, as indicated on the front panel meter, either the driver or power amplifier tubes may require replacement. If the power amplifier tubes are replaced, reneutralization may be required. The neutralizing capacitor is located just to the right of the speaker, and must be adjusted with an insulated alignment tool from the bottom side of the chassis. Proper neutralization is indicated when maximum output and minimum plate current occur with the same setting of the PA TUNE control. This adjustment should be made with the set tuned for 15-meter operation.

LOW RECEIVER SENSITIVITY

Since the receive portion of the transceiver is fully transistorized, no loss in sensitivity should be experienced with age. If the receiver seems to be lacking in sensitivity, the following transformers may be peaked up on noise without interfering with the transmit function:

- T1 Single Slug (May affect carrier balance on transmit. Re-balance carrier).
- T2 Top and Bottom slugs..
- T3 Align with set tuned to 3.9 mc. Adjust 2 slugs.

Low audio output or distortion may also be traced to leaky or shorted electrolytic capacitors in the audio portions of the receiver or transmitter. These will usually cause abnormal voltage readings at the various stages. Refer to the voltage chart on the reverse side.

REMOVAL AND REPLACEMENT OF GONSET'S HUMBUCKER

Gonset's Humbucker, (patent applied for) is shown in the equipment top view on the reverse side. This device cancels out the interaction of the power supply and audio stages, and effectively eliminates any source of 60 cycle hum from the unit. It may be easily removed to allow servicing of the equipment, and slips readily back into place when service is complete.

ALIGNMENT

WARNING

Dangerous high voltage is present in the equipment whenever the unit is turned on. The high voltage filter capacitors remain charged at all times and can cause fatal shock under certain conditions. Allow at least five minutes after the unit is turned off for the filter capacitors to discharge. Always remove the line plug from the outlet when servicing the set. The use of an isolation transformer is recommended when the set is operated for any reason outside of the cabinet.

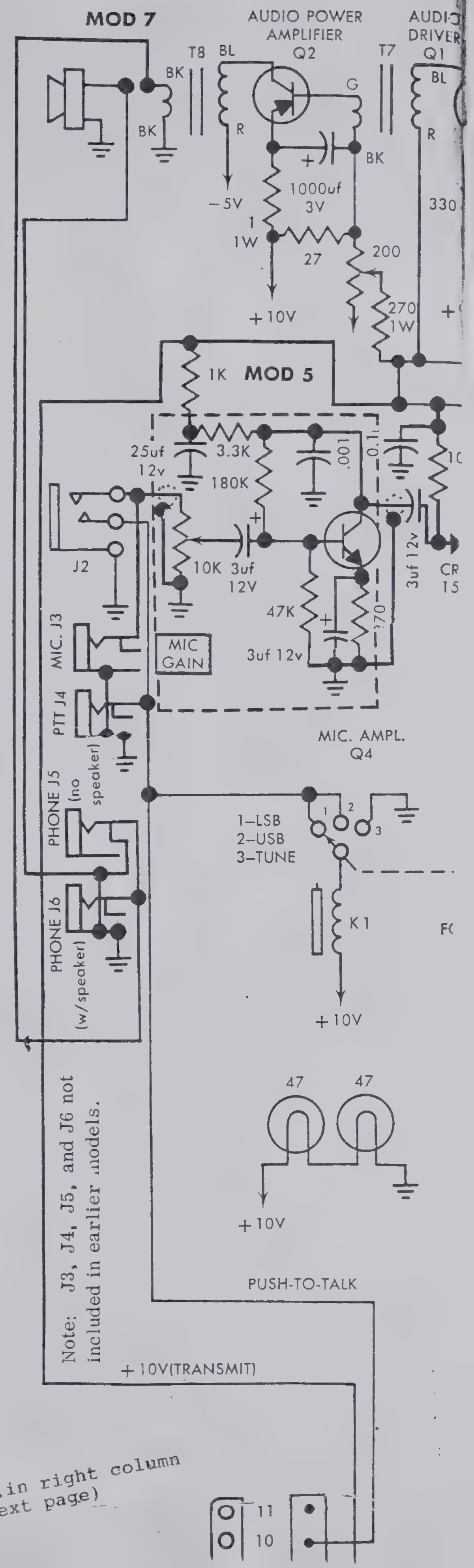
EQUIPMENT REQUIRED

For correct alignment, an accurate vacuum-tube r-f voltmeter such as the Hewlett-Packard HP-410B, a calibrated audio voltmeter, and a well calibrated r-f signal generator such as the Measurements Model 65 B are required. Do not attempt alignment unless thoroughly accurate equipment is available.

ALIGNMENT PROCEDURES

1. CARRIER OSCILLATOR ALIGNMENT. Connect the VTVM to the center arm of the carrier balance potentiometer. Adjust slug of T4 for maximum reading.
2. DOUBLER AND DOUBLER/TRIPLER ALIGNMENT. Connect the VTVM to the base of Q16. Align both slugs of T5 for maximum reading. Then connect the VTVM to Lug E of T6. Set the mode selector to USB. Align both slugs of T6 for maximum output. If the reading exceeds 0.35 volts, rms, rotate the top slug of T5 counter-clockwise until this value is obtained. Now set the mode selector to LSB and align both trimmers on the mode selector switch for maximum meter reading. If the reading exceeds 0.35 volts, rms, adjust either trimmer clockwise until this value is obtained.
3. TI AND T2 ALIGNMENT. Connect a signal generator to lug C of T3. Adjust generator to 2282 kc, unmodulated. Tune generator slightly for a loud beat note in the receiver output, and adjust attenuator for an audio output of 1.0 volt or less as measured across the speaker terminals. Align both slugs of T2 and the single slug of T1 for maximum audio output.
4. CARRIER OSCILLATOR FREQUENCY CHECK. With the setup used in step 3, above, tune the signal generator slightly and find the point of maximum audio output. Take a reference reading on the audio output meter, then tune the signal generator toward zero beat. Note the point at which the audio output is reduced to a value of half of the reference reading. The beat note at this point should be 300 cycles ± 100 cycles. If it is not within this range, readjust T4 slightly as required. T4 may be adjusted only through a limited range since carrier oscillator output will fall below the amount required to drive the ring modulator, (at least 0.5 volt, rms), and the doubler and doubler/tripler stages. If it is not possible to satisfy these conditions, replace the carrier oscillator crystal.
5. VFO AND T3 ALIGNMENT. Turn the bandswitch knob fully clockwise, and connect the signal generator to the antenna terminals. Adjust the signal generator for 3425 kc unmodulated. Tune the receiver near 3.8 mc until a beat note is heard. Make certain that the beat is from the signal generator by varying the tuning. With the generator exactly on 3425 kc, adjust the VFO trimmer located just inboard of the small three-gang tuning capacitor, until the beat note zeroes at 3.8 mc on the receiver dial. Now set the generator exactly on 3225 kc, and locate the beat note near 4.0 mc on the receiver tuning dial. Bend the back rotor plate of the rear gang of the small three-gang tuning capacitor as required to make the beat exactly zero at exactly 4.0 mc on the dial. Next set the generator to 3325 kc and locate the beat note near 3.9 on the receiver tuning dial. Align both slugs of T3 for maximum audio output.
6. CRYSTAL OSCILLATOR ALIGNMENT. Unplug the line cord, and remove the pi-network cage cover (two sheet metal screws) and the crystal oscillator shield (one sheet metal screw). Connect the VTVM across the 10-ohm, ½ watt resistor mounted on the crystal oscillator coil, L1. Plug the line cord in and set the bandswitch to 15 meters. With the slug of L1 well out of the coil, gradually screw into the coil until oscillation is indicated on the

(cont.in right column on next page)



...... a second peak is noted near minimum capacity on the trimmer. Finally, turn the trimmer clockwise until 0.25 volt, rms is read on the VTVM.

Now turn bandswitch to 40 meters. Turn the center trimmer, (connected to the bandswitch with a yellow lead) fully clockwise. Then turn counter-clockwise until the first indication of oscillation is noted. Turn the trimmer until VTVM reads 0.25 volt.

Turn bandswitch to 80 meters. Turn inboard trimmer (grey lead) fully clockwise, then slowly counter-clockwise until oscillation starts. Continue until output on VTVM is 0.25 volt. Now rotate bandswitch through all four bands and check that meter reads 0.25 volt on all bands. A reading of 0.2 is acceptable on 15 meters. Remember that any adjustment of the slug affects the adjustment of the other three bands. Unplug the line cord, and replace the shields

7. RECEIVER RF AMPLIFIER AND HIGH FREQUENCY MIXER ALIGNMENT. Plug in the line cord. Set the bandswitch to the center of the 15 meter arc. Connect the signal generator to the antenna terminals and set the generator to 21.350 mc, unmodulated. Tune the transceiver to 21.350 mc, and adjust for an audible beat note. Reduce the signal generator output so that the receiver audio output does not exceed 0.5 volt with the VOLUME control fully clockwise. Adjust the front and center trimmers on the side of the large three-gang tuning capacitor for maximum audio output. Now turn the bandswitch to the clockwise end of the 80-meter arc. Set the tuning dial at 3.8 mc, and adjust the signal generator around 3.8 mc for an audible beat note, reducing the generator output as required to keep the audio output below 0.5 volt. Adjust the front end center slugs of the three controlled by the bandswitch, for maximum audio output. A thin insulated screwdriver is required for this adjustment. The slug ends are slotted, and may be engaged through the coil mounting clip holes. After both slugs are peaked, check to see that receiver noise peaks up near the center of the 40- and 20-meter arcs.

8. FINAL ADJUSTMENT OF VFO. Adjust the receiver to 14.2 mc, and accurately set the signal generator to 14.2 mc. Adjust the VFO trimmer so that zero beat occurs at exactly 14.2 mc on the receiver dial. Check the lower edges of the other three bands. They should all be within 3 kc of correct dial setting. This completes the receiver function alignment.

9. PRELIMINARY BALANCED MODULATOR ALIGNMENT. Connect the VTVM to the collector of Q6. Turn the MIC. GAIN fully counterclockwise and press the microphone button. Adjust the carrier balance potentiometer and carrier balance trimmer alternately for minimum meter reading.

10. TRANSMITTER DRIVER ALIGNMENT. Connect a 50-ohm dummy load to the antenna terminals, and set the bandswitch to the center of the 15-meter arc. Turn the bias adjust potentiometer fully counter-clockwise. Connect the VTVM to the rear stator lug of the large three-gang variable capacitor. Apply a 20-microvolt, 400 cps audio signal to the microphone input jack .With the microphone button pressed, advance the MIC. GAIN control clockwise until a substantial reading is noted on the VTVM. Peak the rear trimmer on the side of the large variable capacitor for maximum meter reading. Now reduce the audio tone to zero: The meter reading should fall to almost zero. If it does not, the trimmer is probably tuned to the 24.6 mc injection frequency. Make certain that the trimmer is peaked on the 21 mc. sideband signal.

Now turn the bandswitch to the clockwise edge of the 80-meter arc. With the audio tone applied, adjust the rear slug of the three connected to the bandswitch for maximum meter reading.

11. POWER AMPLIFIER ALIGNMENT. Turn the MIC. GAIN control fully counter-clockwise. Set the METER switch to PL. MA. X 100. Press the microphone button and gradually turn the bias adjust potentiometer clockwise until a reading of about 0.8 is indicated on the front-panel meter. Connect the VTVM across the antenna terminals and apply a two-tone test signal to the microphone jack. Turn up the MIC. GAIN control until some drive ap-

(6.continued) FROM PREV. PAGE !!
as indicated on the VTVM. Continue past this peak. Continue screwing the slug into the coil until the VTVM reads 0.25 volts, rms. If the reading does not reach this value with any slug setting, a reading of 0.2 is ok. Now rotate the bandswitch to 20 meters. Turn the outboard or three mica compresion trimmers next to the speaker(connected to the bandswitch by a red lead) until oscillation is indicated on the VTVM. Continue past this peak until a second peak is noted near minimum capacity on the trimmer. Finally...... see left)

pears as evidenced by a rise in plate current. With a monitor s
(Heath Kit or equivalent) connected to the antenna conne
tune the PA TUNE and PA LOAD controls as required to ob
adequate drive. Repeak the rear slug of the three connected to
bandswitch for maximum drive. It should be possible to ob
at least 60 volts on the VTVM with no evidence of flat top
on the monitor scope.

Now turn the bandswitch to the center of the 15 meter arc, and
up the MIC. GAIN control to obtain some drive to the po
amplifier. If any evidence of self-oscillation or instability is
on the monitor scope, adjust the neutralizing capacitor as neces
to eliminate it. Peak the rear trimmer on the side of the la
three-gang variable capacitor for maximum driv. Adjust the
TUNE and PA LOAD controls for maximum output. It sho
be possible to obtain at least 50 volts on the VTVM with no
dence of flat-topping.

Now carefully adjust the neutralizing capacitor until maxim
output occurs at the same setting of the PA TUNE contro
minimum plate current. This indicates proper neutralizat
Finally, repeak the rear trimmer on the three-gang capacitor.

Check to see that maximum drive on all bands occurs at the sa
bandswitch setting that produces maximum receiver noise.
discrepancy is found on the 40 or 80 meter band, adjust the
slug for the best compromise setting. If any discrepancy exists
the 20- and 15-meter bands, adjust the rear trimmer for the
compromise setting.

12. 24 MC TRAP COIL ADJUSTMENT. Set the transmitter cont
for maximum output on 15 meters. Then turn the MIC. GA
control fully counter-clockwise. Turn the PA TUNE control clo
wise toward minimum capacity) until a small rise in VTVM re
ing is found. Now carefully adjust the slug of the 24 mc trap
located between the two three-gang capacitors for minimum VT
reading. The reading should dip to approximately 1.0 volt or

13. FINAL CARRIER BALANCE ADJUSTMENT. Return the
TUNE capacitor to the setting that provides maximum 15-m
output with the MIC. GAIN advanced. Turn the MIC. GAIN
trol fully counter-clockwise, alternately adjust the carrier bala
potentiometer and the carrier balance capacitor for minim
VTVM reading. Set the mode selector to the opposite sideba
The VTVM should read 0.15 volt or less on either sideband.
completes the transmit function alignment.

GENERAL DESCRIPTION

Sideband Engineers Inc. Model 33, is a single sideband, suppressed carrier transceiver designed specifically for use on the phone portions of the 80-, 40-, 20-, and 15-meter amateur radio bands. Operation may be either upper or lower sideband, selection being made through a front-panel control. Transmission is on the exact carrier frequency being received, and there is no carrier shift in changing from upper to lower sideband operation. Peak effective power output exceeds 70 watts on 80-, 40-, and 20-meters, and 50 watts on 15-meters.

The transceiver is self-contained-only a microphone and an antenna are required for operation from a nominal 117-volt a-c power source. Operation is possible from a mobile or portable source through use of a transistorized d-c to a-c inverter which is available as an accessory. Provisions have been made for the addition of a VOX-audio compression unit which is also available as an accessory.

Basic circuitry of the SB-33 is solid-state. Transistors are utilized in all low-level stages, vacuum tubes are used in only the transmitter driver and power amplifier stages. The use of bilateral amplifier and mixer stages which amplify in one direction in transmit and in the other direction in receive, permits use of a single bandpass circuit train. Duplication of circuitry is eliminated, and performance is optimized through use of common circuit elements in both the receive and transmit modes.

A unique bandswitching and exciter tuning control allows both functions through a single front-panel control knob. Other controls and adjustments are held to a minimum. Stability and selectivity are exceptionally high. The design is such that the few heat producing components are isolated from the frequency determining elements. All voltages to the low-level stages are regulated and the VFO is temperature compensated. Selectivity of 2.1 kc at 6 db is achieved on both transmit and receive through use of a COLLINS mechanical filter.

The entire one-package installation is less than one-half cubic foot, weighs approximately 15 pounds, and is entirely self-contained, including power supply and speaker. Because of the revolutionary new circuitry, (patents pending), and unique design, you have the smallest, best performing SSB transceiver available today at any price.

SPECIFICATIONS

TYPE OF EMISSION	Single sideband, suppressed carrier, upper or lower sideband selectable from front panel.
FREQUENCY RANGE	3.8 to 4.0 mc, 7.15 to 7.35 mc, 14.2 to 14.4 mc, 21.25 to 21.45 mc.
POWER CONSUMPTION	Receive 35 watts, Transmit 165 watts (single tone transmit)
POWER OUTPUT	80, 40, 20-meters, 70 watts, min., 15 meters 50 watts, min.
CARRIER SUPPRESSION	50 db
UNWANTED SIDEBAND SUPPRESSION	40 db
DISTORTION PRODUCTS	Down at least 25 db
SPURIOUS RESPONSE	Down at least 40 db
ANTENNA OUTPUT IMPEDANCE	40 to 100 ohms, unbalanced. VSWR not to exceed 2:1
SENSITIVITY	Less than 1 microvolt for 10 db signal-to-noise ratio.
SELECTIVITY	2.1 kc at 6 db down, 4.5 kc at 60 db down, both transmit and receive.
AUDIO OUTPUT	[illegible]

SBE SIDEBAND ENGINEERS, INC.
RANCHO SANTA FE, CALIFORNIA

OPERATION and SERVICE

SB 33 SINGLE SIDEBAND TRANSCEIVER

GENERAL DESCRIPTION

Sideband Engineers Inc. Model 33, is a single sideband, suppressed carrier transceiver designed specifically for use on the phone portions of the 80-, 40-, 20-, and 15-meter amateur radio bands. Operation may be either upper or lower sideband, selection being made through a front-panel control. Transmission is on the exact carrier frequency being received, and there is no carrier shift in changing from upper to lower sideband operation. Peak effective power output exceeds 70 watts on 80-, 40-, and 20-meters, and 50 watts on 15-meters.

The transceiver is self-contained-only a microphone and an antenna are required for operation from a nominal 117-volt a-c power source. Operation is possible from a mobile or portable source through use of a transistorized d-c to a-c inverter which is available as an accessory. Provisions have been made for the addition of a VOX-audio compression unit which is also available as an accessory.

Basic circuitry of the SB-33 is solid-state. Transistors are utilized in all low-level stages, vacuum tubes are used in only the transmitter driver and power amplifier stages. The use of bilateral amplifier and mixer stages which amplify in one direction in transmit and in the other direction in receive, permits use of a single bandpass circuit train. Duplication of circuitry is eliminated, and performance is optimized through use of common circuit elements in both the receive and transmit modes.

A unique bandswitching and exciter tuning control allows both functions through a single front-panel control knob. Other controls and adjustments are held to a minimum. Stability and selectivity are exceptionally high. The design is such that the few heat producing components are isolated from the frequency determining elements. All voltages to the low-level stages are regulated and the VFO is temperature compensated. Selectivity of 2.1 kc at 6 db is achieved on both transmit and receive through use of a COLLINS mechanical filter.

The entire one-package installation is less than one-half cubic foot, weighs approximately 15 pounds, and is entirely self-contained, including power supply and speaker. Because of the revolutionary new circuitry, (patents pending), and unique design, you have the smallest, best performing SSB transceiver available today at any price.

SPECIFICATIONS

TYPE OF EMISSION	Single sideband, suppressed carrier, upper or lower sideband selectable from front panel.
FREQUENCY RANGE	3.8 to 4.0 mc, 7.15 to 7.35 mc, 14.2 to 14.4 mc, 21.25 to 21.45 mc.
POWER CONSUMPTION	Receive 35 watts, Transmit 165 watts (single tone transmit)
POWER OUTPUT	80, 40, 20-meters, 70 watts, min., 15 meters 50 watts, min.
CARRIER SUPPRESSION	50 db
UNWANTED SIDEBAND SUPPRESSION	40 db
DISTORTION PRODUCTS	Down at least 25 db
SPURIOUS RESPONSE	Down at least 40 db
ANTENNA OUTPUT IMPEDANCE	40 to 100 ohms, unbalanced. VSWR not to exceed 2:1
SENSITIVITY	Less than 1 microvolt for 10 db signal-to-noise ratio.
SELECTIVITY	2.1 kc at 6 db down, 4.5 kc at 60 db down, both transmit and receive.
AUDIO OUTPUT	2.0 watts at 10 percent distortion, 3 watts max.
DIMENSIONS	5½ in. high, 11¾ in. wide, 10¼ in. deep.
WEIGHT	Approximately 15 pounds.

WARRANTY

Sideband Engineers Inc. warrants this equipment against defects in materials and workmanship, except for tubes and transistors, under normal service for a period of ninety days from date of purchase. This warranty is limited to repairing or replacing the defective parts and is not valid if the equipment has been tampered with, misused, or damaged. Do not forward equipment for warranty service without prior written authorization from factory. Return equipment for warranty service to:

For Service Call SK 5-4133
Area Code 714

Sideband Engineers Repair Dept.
143 South Cedros, Solana Beach, Calif.

INSTALLATION

The SB-33 Transceiver has been designed to provide a complete single package installation that is suitable for use in fixed, portable, and mobile installations. No special precautions need be observed in the choice of location, as long as adequate ventilation space is provided. A minimum of two inches of air space above the cabinet top, and on all sides, is recommended to allow proper ventilation through the slots on the top and bottom of the cabinet. Do not put the unit on a car seat or any other similar surface which will block ventilation through the bottom.

POWER

A 117-volt ac power cord is furnished with the transceiver. All connections for a-c operation are made by plugging it into the receptable on the rear panel of the unit. The white ground lead that is supplied as part of the power cord should be connected to a good ground, such as a water pipe. This is not necessarily an RF ground, but is only an a-c ground. The power plug must be properly polarized when it is plugged into the power outlet. A small neon lamp is mounted on the rear panel to indicate proper polarity. With the ground lead connected to a suitable ground, and the transceiver turned OFF, insert the power plug into the outlet. If the neon lamp glows, reverse the plug in the outlet. No damage to the set will result if the plug is incorrectly polarized, but some hum modulation is likely to appear on the transmitted signal.

ANTENNA

Results both in receiving and transmitting with the transceiver will depend largely on the antenna used. The receive mode is particularly sensitive to the antenna used. Any of the common antenna systems designed for use on the high frequency amateur bands may be used with the SB-33 Transceiver, provided the input impedance of the antenna system is within the capability of the pi-output matching network, (40 to 100 ohms, resistive). Any antenna system which meets these requirements will provide satisfactory results. If tuned open-wire transmission line is used, or if a long wire antenna is desired, a suitable antenna tuner should be used between the unit and the antenna to provide an impedance match between the unbalanced coaxial output and the balanced open-wire line or long wire. For mobile operation, the antenna should be mounted so that the effects of detuning from changes in the relation of the car body and antenna are minimized.

LINEAR AMPLIFIER

The SB-33 Transceiver may be operated in conjunction with any conventional linear amplifier. A 10-volt keying voltage is provided on pin 7 of the power receptacle for controlling the linear amplifier. If the control relays in the amplifier are not designed to operate from such a voltage, an intervening relay will be needed to adapt the particular amplifier used. Any 12-volt d-c relay may be used, provided that the coil resistance is 75 ohms or less. If in doubt as to the suitability of the amplifier to be used, contact Sideband Engineers Inc., enclosing the schematic diagram of the amplifier to be used.

MOBILE OPERATION

Operation of the transceiver from a 12-volt d-c battery source is possible through a special transistorized d-c to a-c inverter which is available as an accessory. A locking-type mobile mounting base is also available. Operation from a conventional vibrator inverter is possible, but will result in lowered transmitter output since the high voltage supply in the transceiver will not respond correctly to the square-wave voltage output these inverters deliver.

Any of the commercially available mobile antennas may be used with the SB-33 transceiver. Results on bands other than that to which the antenna is tuned will be poor. It is essential that the particular antenna be resonant on the band used.

OPERATION

Note

The SB-33 transceiver has been specifically designed to provide the utmost ease of operation, and all panel controls have been thoroughly checked before shipment from the factory. Several of the front-panel controls are unusual in operation, however, and improper adjustment may result in signals of poor quality, and even out-of band operation. Read this section carefully before attempting to operate the transceiver.

CONTROL FUNCTIONS

The various front-panel controls, and their functions, are described in detail in the following paragraphs. Make certain that you understand the function of each control before attempting to operate the transceiver. Detailed instructions are given for tuning the transmitter. The design of the unit is such that when the transmitter is properly tuned, the receiving portion of the unit is also properly aligned to the frequency being used.

VOLUME CONTROL. The power ON/OFF and volume control (RF gain) functions are combined on a single control knob located at the lower left corner of the front panel. Operating the knob clockwise beyond the click turns the unit on. With mobile installations, this control turns the inverter on. Volume in receive is set to the desired level by turning the knob further clockwise. Since the receiver is fully transistorized, no warm-up period is required.

TUNING KNOB. The large knob directly to the right of the volume control knob controls the VFO tuning, and sets the exact frequency of receiving and transmitting simultaneously within the selected band. The various fre- [illegible] above the tuning knob. Tuning single sideband signals requires careful adjustment of the tuning control. If no adjustment of the tuning knob will permit intelligent reception of a single sideband signal, it is quite likely that the station is transmitting on the sideband other than the set is adjusted for. See MODE SELECTOR, below.

MICROPHONE CONNECTOR. The MIC. jack is located directly to the right of the tuning knob, and accepts a standard PL-68 microphone plug. The microphone should be connected to the ring, and the push-to-talk switch connected to the tip. The SB-33 transceiver is designed to operate with a medium-to-high impedance dynamic microphone, such as the Turner Model SR90D, or equivalent. Crystal or ceramic microphones will give poor results, unless an auxiliary preamplifier is used, because of the mismatch between the exceptionally high impedance microphone and the low impedance transistor microphone amplifier. Carbon microphones also will operate only if external provisions are made for their use.

BANDSWITCH. The bandswitching and exciter tuning functions are combined in a single knob located just below the meter. With the knob indication fully clockwise, the transceiver is set on 80 meters, and the front end of the receiver is peaked by rotating the knob through the arc labeled "80". Correct setting is indicated by a sharp rise in background noise similar to that obtained with the "antenna tuning" control on a conventional receiver. To change to 40 meters, the knob is rotated counter-clockwise beyond the 80-meter arc. A click will be heard between the 80- and 40-meter arcs. This is the bandswitch operating to the 40-meter position. Tuning is again performed by rotating the knob through the 40-meter arc, and is indicated by a sharp rise in noise. This is progressively repeated for operation on the 20-, and 15-meter bands. A stop is provided at the extreme counter-clockwise rotation past the 15-meter arc. Do not attempt to rotate the knob past this stop. No damage will result, but the knob may slip and cause loss of calibration. If this should happen, turn the bandswitch knob fully clockwise, loosen the knob setscrew, and set the knob index exactly on the clockwise stop mark on the panel. Tighten the setscrew securely. Further adjustment of the bandswitch knob is covered in the TRANSMITTER TUNEUP section.

MODE SELECTOR. Just to the left of the meter is the Mode Selector knob. With the knob set on LSB, the transceiver is adjusted to receive and transmit a lower sideband signal. Upper sideband operation is selected by moving the knob to USB. In the TUNE position, the transceiver is placed in the transmit condition, and sufficient carrier is inserted to allow tuning of the final amplifier stages. The majority of single sideband operation on 80 and 40 meters is lower sideband, and practically all 20- and 15-meter operation is upper sideband. If operation is on one sideband, and it is desired to change to the other sideband, no change in tuning is required.

TRANSMITTER CONTROLS. The controls used exclusively in transmitting are clearly labelled on the panel, MIC. GAIN, PA TUNE, PA LOAD, METER SWITCH. Their function is described in the TRANSMITTER TUNING section.

RECEIVER OPERATION

The SB-33 transceiver employs a 2.1 kc COLLINS mechanical filter to attain exceptional selectivity on both receive and transmit. The unit is designed to pass only that portion of the voice spectrum falling between 300 and 2400 cycles. Experience has shown that this bandwidth permits excellent intelligibility and still discriminates against interfering noise. Since the transceiver audio system and speaker is also carefully shaped to pass only 300 to 2400 cycles, the end result is reception similar to the quality of a conventional telephone. No setting of the transceiver will produce "high fidelity" reception in the normal sense. The SB-33 will, however, provide good communications under conditions of high noise and weak signals when conventional receivers with extended audio range and wide bandpass are completely unusable.

Every effort has been made to prevent the receiver from overloading or blocking on strong signals. Since the volume control affects only the RF section of the receiver, rather than the customary audio circuits, the receiver is *less likely to overload at low volume settings than at high settings.* Quite often interference from close-by stations can be completely eliminated by merely reducing the volume control setting. A limited action automatic gain control system (AGC) is incorporated in the transceiver. It provides strong compression on signals when the audio output exceeds approximately one-quarter watt. Its primary purpose is to eliminate the "flutter" when operating mobile, but will also be very useful for "roundtables" where received signal strengths may vary greatly.

SPURIOUS SIGNALS. A few spurious responses or "birdies", may be noted as the receiver is tuned through the various bands. With a normal antenna, and in an average location, all of these responses will be below the level of a readable signal, with the possible exception of a single response at 7300.8 kc. Since this response is outside the amateur bands, it should cause no inconvenience to the operator. It is, in fact, useful as a means of checking the dial accuracy, since it has the stability of the carrier oscillator, and may be relied upon to be accurate as a frequency marker.

TRANSMITTER TUNEUP

Note

Improper transmitter tuning can result in [illegible] even out-of-band operation. Improper adjustment of the Mic. Gain can result in "flat-topping" and the generation of splatter and other spurious emission. [illegible] ke certain you understand the following instructions thoroughly before you attempt to operate the transmitter.

Transmitter tuneup consists of adjusting the exciter, loading the power amplifier to the antenna, and setting the microphone gain control for optimum results. The SB-33 Transceiver has been carefully designed to minimize the possibility of improper operation due to faulty tuning procedures, and to make the tuneup procedure as simple and quick as possible. The combination bandswitch and exciter tuning, for instance, has been designed to preclude the possibility of tuneup on incorrect frequencies. It is, however, possible to transmit a poor signal if the set is not correctly tuned. Take the time to memorize the following step-by-step procedure, and your SB-33 Transceiver will always transmit a clean, powerful signal that will be a credit to your station.

EXCITER TUNING. With the transceiver turned on, allow 30 seconds for warmup of the transmitter driver and power amplifier stages. Set the bandswitch to the desired band, *making certain that an antenna resonant to that band is connected.* Set the bandswitch knob for maximum noise, as outlined in previous instructions. Set the MIC. GAIN, PA LOAD, and PA TUNE controls full counter-clockwise, and the METER switch in PL. MA. X 100 position. Now turn the mode selector switch to TUNE position. The receiver will be quiet, and some indication will appear on the meter. Carefully adjust the bandswitch knob for maximum meter indication. This will occur at a setting very close to that which produced maximum receiver noise. One or more peaks may be evident if the bandswitch knob is tuned through the entire arc, but the correct setting will always be near the point of maximum receiver noise, and will always produce a much higher meter reading. The exciter is now tuned.

POWER AMPLIFIER TUNING. Turn the PA TUNE control clockwise until a sharp dip in meter indication occurs. At this point, switch the meter to OUTPUT position. Some meter indication will be evident. Turn the PA LOAD control clockwise to the point that produces maximum meter indication. Then readjust the PA TUNE control for maximum meter indication. Repeat alternating adjustment of PA TUNE and PA LOAD controls until the meter reads maximum possible, with final adjustment made of the PA TUNE control. This completes the exciter and power amplifier tuneup.

MICROPHONE GAIN ADJUSTMENT. Turn METER switch to PL. MA. X 100, and mode selector to TUNE long enough to note meter reading. With the transceiver properly tuned to a resonant antenna, the reading should be between 2.0 and 2.5. Return the mode selector to the desired sideband, and press the microphone button and speak a steady "AHHH" into the microphone at the level and distance you intend to use when transmitting. Gradually turn the MIC. GAIN control clockwise until the meter reading increases to approximately 1.5 if the maximum reading was 2.5, or 1.3 if the maximum reading was 2.0. This setting of the MIC. GAIN control will ensure a strong transmitted signal without danger of overdriving.

Note

It is very important that the MIC. GAIN control be correctly set. If it is too high, voice peaks will overdrive the power amplifier to a non-linear condition, resulting in flat-topping. Exact setting will depend onthe microphone used, and how close and loud the operator speaks. It may be possible to increase the setting of the MIC. GAIN control while another station checks your signal, but such on-the-air reports are subject to many inaccuracies.

THEORY OF OPERATION

The SB-33 single sideband transceiver is essentially bilateral. With the exception of the receiver RF Amplifier and the high-level transmitting stages, the signal stages may amplify in either direction. During the receive function they amplify in one direction, on transmit they amplify in the opposite direction. The same tuned circuits are used for both transmitting or receiving. The various injection oscillators operate continuously, supplying the local oscillator signals to the proper mixer stages.

All transistors in the transceiver operate in the common emitter configuration, with the exception of the Receiver RF Amplifier, Q12. This stage operates common base. (See Schematic on reverse side).

A typical bilateral amplifier stage may be understood by referring to the 456 KC Amplifier, Q6 and Q7, in the schematic diagram. With relay K1 de-energized, or in receive position, the 33K base bias resistor of Q6 is returned through the relay contacts to the 10-volt bus. Since the emitter of Q6 is also connected to 10 volts, no base current flows, and the transistor remains cut off. The 18 K base bias resistor of Q7 is returned through the volume control and relay contacts to ground. With the volume control advanced, Q7 conducts and amplifies any signal appearing on its base. Thus, with the relay de-energized, this stage will amplify a signal appearing at the mechanical filter, FL-1, and the amplified output will be impressed on the i-f transformer T1. With the relay energized, or in transmit position, the reverse occurs, and Q6 conducts while Q7 is cut off. A signal appearing at T1 will be amplified and fed to filter FL-1. Similarly, the amplifying direction of the VFO Mixer, Q8 and Q9, and the High Frequency Mixer Q10 and Q11, is controlled by the relay. Unilateral stages that are required to operate only on receive or transmit are turned off when not in use by returning their base bias resistors to the appropriate relay contact. The transmitter tubes are disabled during receive by opening their cathode leads.

TRANSMIT FUNCTION

An audio signal from the microphone, controlled in amplitude by the MIC. GAIN control, is amplified by the Microphone Amplifier, Q4, and applied to the base of the Signal Splitter, Q5, which acts as an emitter follower. The low-impedance output from Q5 drives a ring balanced modulator, CR1-4. Crystal Oscillator, Q14, operating at 456.45 kc, provides a carrier to the balanced modulator through Emitter Follower, Q13. Carrier balance is obtained by a potentiometer and a trimmer capacitor. Double sideband, suppressed carrier output from the balanced modulator is amplified through T1 by the bilateral 456 KC Amplifier, Q6 and Q7. The amplified signal is then passed through Mechanical Filter FL-1 which suppresses the upper sideband.

Output from Crystal Oscillator, Q14, is also applied to Frequency Doubler Q15. The doubled frequency from Q15 is then either doubled again or tripledby Q16. With the mode selector switch set to LSB, the frequency is doubled, with the switch on USB, it is tripled. Thus, on LSB a 1825.8 kc (456.45 X 4) signal appears on lug E of T6. On USB, a 2738.7 kc (456.45 X 6) output appears.

Doubler/tripler transformer T6 is connected in a ring with filter FL-1, Sideband Selector Mixer CR5, and transformer T2, which is tuned to 2282.25 kc, to form a ring mixer. With the mode selector on LSB, 1825.8 kc output from T6 is additively mixed with the filter output, 456.45 kc, to produce a 2282.25 kc lower sideband signal at T2. With the mode selector set on USB, the 2738.7 kc output from T6 is subtractively mixed with the filter output to produce a [illegible] upper sideband signal at T2. Thus, the mode selector determines the mode of the sideband signal by setting the Doubler/Tripler, Q16, to either double or triple the second harmonic of the carrier oscillator. [illegible] TUNE position, operation is USB, and a measured amount of carrier signal is inserted in the d-c load resistor of CR5, for tuneup.

The 2282.25 kc upper or lower sideband output from T2 is applied to the bilateral VFO Mixer, Q8 and Q9. Also applied to this mixer is an injection signal between 5507.25 kc and 5707.25 kc. The frequency of this injection is controlled by the main tuning knob, and determines the final output frequency within the selected band. This frequency is generated by the VFO, Q18, and amplified by VFO Buffer Q17. Buffer coil L4 broadly tunes the buffer to provide constant output across the VFO range.

Tunable i-f transformer T3, connected to the output of VFO Mixer Q8 and Q9, tunes the frequency range 3225 kc through 3425 kc. This frequency range is the result of mixing the incoming 2282.25 kc sideband signal with the VFO injection frequency, and can be either upper or lower sideband, depending on the mode selected. Transformer T3 is gang-tuned with the VFO, and thus is always accurately tuned to the desired frequency.

The 3225 kc to 3425 kc sideband signal output from VFO Mixer Q8 and Q9 is applied to the bilateral High Frequency Mixer, Q10 and Q11. Also applied to this mixer is an injection frequency from the High Frequency Crystal Oscillator, Q3. On 80 meters, this oscillator produces output at 7225 kc, controlled by crystal Y2. On 40, 20, and 15 meters, Q3 is connected as an overtone oscillator, with the overtone frequency being determined by the resonant frequency of L1 and the trimmer capacitor switched in by the bandswitch. Crystal Y3, with a fundamental frequency of 3525 kc, operates on its third overtone on 40 meters, (10,575 kc), on its fifth overtone on 20 meters, (17,625 kc) and on its seventh overtone on 15 meters, (24,675 kc). The 3225 to 3425 kc single sideband signal is subtractively mixed with the injection frequency on all bands, resulting in consistent dial readings and sideband selection. The output of High Frequency Mixer Q10 and Q11, the final output frequency, appears across coil L2. The resonant frequency of L2 is controlled both by a large variable capacitor and a special slug which penetrates the coil by an amount dependent upon the setting of the bandswitch. The large variable capacitor is mechanically linked to the bandswitch through a Geneva movement (Patent Applied for) so that rotating the variable capacitor shaft tunes the coil through a limited range, bracketing the given operating band, then changes the bandswitch to the next band, tuning a limited range bracketing this band, etc. On 80 meters the slug is almost fully penetrated into the coil, and the variable capacitor is near maximum capacity. On 40 and 20 meters, the slug and capacitor are at near mid-range, and on 15 meters, the slug is fully withdrawn from the coil and the capacitor is near minimum. In this unique method of tuning and bandswitching, the Q and inductance/capacitance ratio of L2 and the variable capacitor are near optimum on all bands, and the resonant impedance remains essentially constant across the tuning range. This tuning is linked with, and duplicated in, antenna coil L3 and driver coil L6, to result in exciter train tuning with only one control.

The single sideband, suppressed carrier final output signal from L2 is applied to the grid of Transmitter Driver V1, where it is amplified, and appears across L6. A low-impedance winding on L6 couples the signal to the parallel grids of Power Amplifiers V2 and V3. Neutralization of the power amplifiers is accomplished by feeding back a small amount of the output through Cn to the top of L6, with the low impedance winding providing the necessary phase reversal.

Final output from V2 and V3 is fed to a pi-section network consisting of L7 and the PA TUNE and PA LOAD capacitors. A section of the bandswitch adjusts the inductance of L7 to the correct value for each band, and also adds fixed amounts of capacity to both the PA LOAD and PA TUNE capacitors on 80 meters.

RECEIVE FUNCTION

With relay K1 de-energized, a signal from the antenna is coupled through a low-impedance tap to antenna coil L3. Diode CR6 is essentially paralleled across the coil and conducts only when extremely strong signals are present, thus protecting the Receiver RF Amplifier Q12 from the possibility of burning out. On transmit, diode CR6 is forward biased, effectively shorting L3 at all times.

The signal at L3 is coupled to the emitter of Receiver RF Amplifier Q12, which operates as a common-base amplifier. The gain of the stage is controlled by AGC Amplifier Q19. A measured amount of the audio output signal is rectified by Q19 and used to bias the emitter of Q12 toward cutoff. Q12 operates at full gain on very weak signals, but cuts off in the presence of even a moderate signal, thus protecting the following stages from overload.

The amplified signal from Q12 is applied to bilateral High Frequency Mixer Q10 and Q11. With injection from Q3, this stage converts the signal to a frequency within the range 3225 to 3425 kc. The converted signal is then mixed by Q8 and Q9 to 2282.25 kc with injection received from VFO Q18 and VFO Buffer Q17.

Output from VFO Mixer Q8 and Q9 is converted by diode CR5 to the 456.45 kc reference frequency in a manner exactly opposite to that described for this stage during the transmit function. The filter output from FL-1 is then amplified by Q6 and Q7 and coupled through T1 to the ring modulator, CR1-4.

With BFO injection from the carrier oscillator, the ring modulator now functions as a detector, and produces an audio output which is applied to the emitter of Signal Splitter Q5. On receive, Q5 operates as a common-base amplifier, with output taken from the collector and applied to Audio Driver Q1. Output from the driver is passed through transformer T7 to Audio Power Amplifier Q2, and then to the speaker through T8.

The VOLUME (RF gain) control sets the gain, on receive only, of the bilateral High Frequency Mixer and 456 KC Amplifier. VFO Mixer Q8 and Q9, and the audio stages, operate at full gain at all times.

POWER SUPPLY

High voltage of approximately 480 volts is furnished to the transmitter driver and power amplifier stages by a voltage tripler, CR-11, CR-12, and CR-13, operating directly from the incoming 117-volt a-c line. Since all parts of the driver and power amplifier stages are electrically isolated from the chassis, no shock hazard exists. However, due to the voltage gradient existing between the voltage tripler and chassis ground, it is necessary to properly polarize the power plug. A neon lamp facilitates proper connection of the plug to the a-c power outlet. As explained in the Installation section, the neon light must be out to indicate proper polarization.

A two-winding transformer supplies the remaining voltages required by the transceiver. One winding operates the series-connected heaters of the driver and power amplifier stages, and in addition is full-wave rectified by diodes CR-8 and CR-9. The filtered output of this winding is approximately 15 volts, and supplies power for the Audio Output Amplifier Q2. In addition, this voltage is series regulated by Q20 and zener diode CR-14 to provide regulated 10-volt output to all other transistor stages except Q1, Q4, Q5, and Q13, which require additional filtering. The voltage for these stages is smoothed by a resistor-capacitor filter operating from the 10-volt bus, and is 9.5 volts.

Bias for the transmitter power amplifier is obtained from the second winding of the transformer, and is rectified by CR-10. The actual value of bias voltage is determined bv the bias-adjust potentiometer.

TROUBLESHOOTING

The SB-33 transceiver has been carefully aligned and tested at the factory, and all adjustments that might become misaligned from the effects of vibration and temperature cycling have been securely locked in place.

Problems that might possibly arise, and their detection and correction, are included in the following paragraphs.

CARRIER BALANCE

The SB-33 transceiver is designed to maintain carrier suppression of at least 50 db below full output for extended periods of time. If for any reason excessive carrier is present, the carrier balance potentiometer on the rear panel should be readjusted. The most accurate method for doing this requires a fairly sensitive vacuum-tube r-f voltmeter, such as the Hewlett-Packard HP-410B, or equivalent, connected across the antenna terminals. With the MIC. GAIN control set fully counter-clockwise, and the microphone button pressed, the residual carrier, as measured by the voltmeter, should be nulled to a value of 0.2 volts rms, or less, by use of the carrier balance potentiometer. Check operation on both sidebands since there may be a slight variation in carrier between the two modes. Any variation should be averaged out by the potentiometer. If it is not possible to reduce the carrier to a reading of 0.2 volts with the potentiometer alone, remove the set from the cabinet, and readjust the carrier balance capacitor located on the chassis top near the rear left corner of the chassis. This capacitor and the potentiometer interact somewhat so that several cycles of adjustment may be required.

LOW TRANSMITTER OUTPUT

Loss of transmitter output generally indicates weak tubes. If the off-resonance plate current of the power amplifier stage becomes somewhat less than 250 ma, as indicated on the front panel meter, either the driver or power amplifier tubes may require replacement. If the power amplifier tubes are replaced, reneutralization may be required. The neutralizing capacitor is located just to the right of the speaker, and must be adjusted with an insulated alignment tool from the bottom side of the chassis. Proper neutralization is indicated when maximum output and minimum plate current occur with the same setting of the PA TUNE control. This adjustment should be made with the set tuned for 15-meter operation.

LOW RECEIVER SENSITIVITY

Since the receive portion of the transceiver is fully transistorized, no loss in sensitivity should be experienced with age. If the receiver seems to be lacking in sensitivity, the following transformers may be peaked up on noise without interfering with the transmit function:

- T1 Single Slug (May affect carrier balance on transmit. Re-balance carrier).
- T2 Top and Bottom slugs..
- T3 Align with set tuned to 3.9 mc. Adjust 2 slugs.

Low audio output or distortion may also be traced to leaky or shorted electrolytic capacitors in the audio portions of the receiver or transmitter. These will usually cause abnormal voltage readings at the various stages. Refer to the voltage chart on the reverse side.

REMOVAL AND REPLACEMENT OF GONSET'S HUMBUCKER

Gonset's Humbucker, (patent applied for) is shown in the equipment top view on the reverse side. This device cancels out the interaction of the power supply and audio stages, and effectively eliminates any source of 60 cycle hum from the unit. It may be easily removed to allow servicing of the equipment, and slips readily back into place when service is complete.

SBE SIDEBAND ENGINEERS, INC.
RANCHO SANTA FE, CALIFORNIA

OPERATION and SERVICE

SB 33

SINGLE SIDEBAND TRANSCEIVER

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Problems that might possibly arise, and their detection and correction, are included in the following paragraphs.

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Loss of transmitter output generally indicates weak tubes. If the off-resonance plate current of the power amplifier stage becomes somewhat less than 250 ma, as indicated on the front panel meter, either the driver or power amplifier tubes may require replacement. If the power amplifier tubes are replaced, reneutralization may be required. The neutralizing capacitor is located just to the right of the speaker, and must be adjusted with an insulated alignment tool from the bottom side of the chassis. Proper neutralization is indicated when maximum output and minimum plate current occur with the same setting of the PA TUNE control. This adjustment should be made with the set tuned for 15-meter operation.

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ALIGNMENT

WARNING

Dangerous high voltage is present in the equipment whenever the unit is turned on. The high voltage filter capacitors remain charged at all times and can cause fatal shock under certain conditions. Allow at least five minutes after the unit is turned off for the filter capacitors to discharge. Always remove the line plug from the outlet when servicing the set. The use of an isolation transformer is recommended when the set is operated for any reason outside of the cabinet.

EQUIPMENT REQUIRED

For correct alignment, an accurate vacuum-tube r-f voltmeter such as the Hewlett-Packard HP-410B, a calibrated audio voltmeter, and a well calibrated r-f signal generator such as the Measurements Model 65 B are required. Do not attempt alignment unless thoroughly accurate equipment is available.

ALIGNMENT PROCEDURES

1. CARRIER OSCILLATOR ALIGNMENT. Connect the VTVM to the center arm of the carrier balance potentiometer. Adjust slug of T4 for maximum reading.
2. DOUBLER AND DOUBLER/TRIPLER ALIGNMENT. Connect the VTVM to the base of Q16. Align both slugs of T5 for maximum reading. Then connect the VTVM to Lug E of T6. Set the mode selector to USB. Align both slugs of T6 for maximum output. If the reading exceeds 0.35 volts, rms, rotate the top slug of T5 counter-clockwise until this value is obtained. Now set the mode selector to LSB and align both trimmers on the mode selector switch for maximum meter reading. If the reading exceeds 0.35 volts, rms, adjust either trimmer clockwise until this value is obtained.
3. TI AND T2 ALIGNMENT. Connect a signal generator to lug C of T3. Adjust generator to 2282 kc, unmodulated. Tune generator slightly for a loud beat note in the receiver output, and adjust attenuator for an audio output of 1.0 volt or less as measured across the speaker terminals. Align both slugs of T2 and the single slug of T1 for maximum audio output.
4. CARRIER OSCILLATOR FREQUENCY CHECK. With the setup used in step 3, above, tune the signal generator slightly and find the point of maximum audio output. Take a reference reading on the audio output meter, then tune the signal generator toward zero beat. Note the point at which the audio output is reduced to a value of half of the reference reading. The beat note at this point should be 300 cycles ± 100 cycles. If it is not within this range, readjust T4 slightly as required. T4 may be adjusted only through a limited range since carrier oscillator output will fall below the amount required to drive the ring modulator, (at least 0.5 volt, rms), and the doubler and doubler/tripler stages. If it is not possible to satisfy these conditions, replace the carrier oscillator crystal.
5. VFO AND T3 ALIGNMENT. Turn the bandswitch knob fully clockwise, and connect the signal generator to the antenna terminals. Adjust the signal generator for 3425 kc unmodulated. Tune the receiver near 3.8 mc until a beat note is heard. Make certain that the beat is from the signal generator by varying the tuning. With the generator exactly on 3425 kc, adjust the VFO trimmer located just inboard of the small three-gang tuning capacitor, until the beat note zeroes at 3.8 mc on the receiver dial. Now set the generator exactly on 3225 kc, and locate the beat note near 4.0 mc on the receiver tuning dial. Bend the back rotor plate of the rear gang of the small three-gang tuning capacitor as required to make the beat exactly zero at exactly 4.0 mc on the dial. Next set the generator to 3325 kc and locate the beat note near 3.9 on the receiver tuning dial. Align both slugs of T3 for maximum audio output.
6. CRYSTAL OSCILLATOR ALIGNMENT. Unplug the line cord, and remove the pi-network cage cover (two sheet metal screws) and the crystal oscillator shield (one sheet metal screw). Connect the VTVM across the 10-ohm, ½ watt resistor mounted on the crystal oscillator coil, L1. Plug the line cord in and set the bandswitch to 15 meters. With the slug of L1 well out of the coil, gradually screw into the coil until oscillation is indicated on the VTVM. Continue screwing the slug into the coil until the VTVM reads 0.25 volt, rms. If the reading does not reach this value with [illegible] 0.2 [illegible] is acceptable. Now rotate the bandswitch to 20 meters. Turn the outboard of the three mica compression trimmers next to the speaker (connected to the bandswitch by a red lead) fully clockwise. Now turn counter-clockwise until oscillation is indicated on the VTVM. Continue past this peak until a second peak is noted near minimum capacity on the trimmer. Finally, turn the trimmer clockwise until 0.25 volt, rms is read on the VTVM.

   Now turn bandswitch to 40 meters. Turn the center trimmer, (connected to the bandswitch with a yellow lead) fully clockwise. Then turn counter-clockwise until the first indication of oscillation is noted. Turn the trimmer until VTVM reads 0.25 volt.

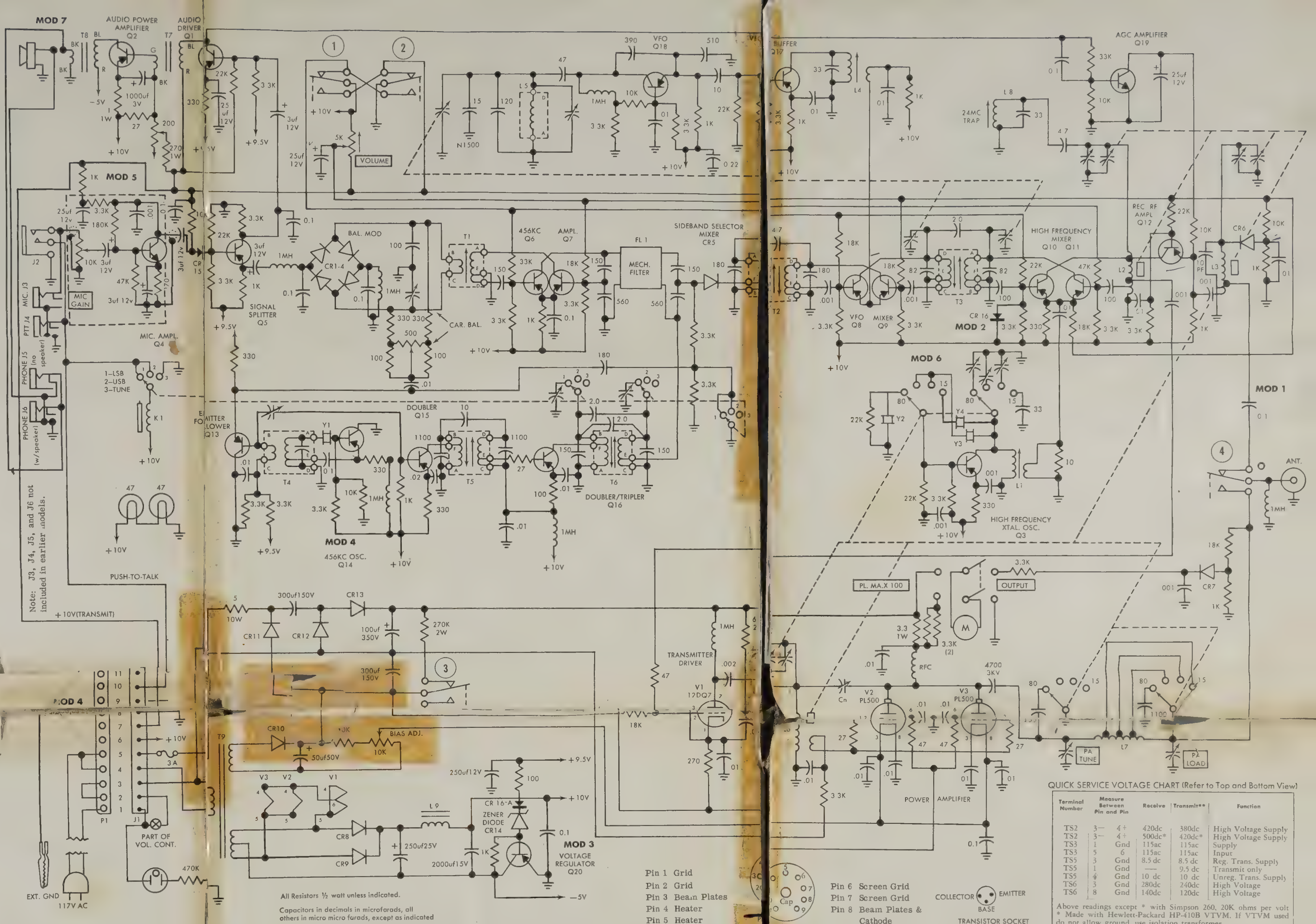
   Turn bandswitch to 80 meters. Turn inboard trimmer (grey lead) fully clockwise, then slowly counter-clockwise until oscillation starts. Continue until output on VTVM is 0.25 volt. Now rotate bandswitch through all four bands and check that meter reads 0.25 volt on all bands. A reading of 0.2 is acceptable on 15 meters. Remember that any adjustment of the slug affects the adjustment of the other three bands. Unplug the line cord, and replace the shields
7. RECEIVER RF AMPLIFIER AND HIGH FREQUENCY MIXER ALIGNMENT. Plug in the line cord. Set the bandswitch to the center of the 15 meter arc. Connect the signal generator to the antenna terminals and set the generator to 21.350 mc, unmodulated. Tune the transceiver to 21.350 mc, and adjust for an audible beat note. Reduce the signal generator output so that the receiver audio output does not exceed 0.5 volt with the VOLUME control fully clockwise. Adjust the front and center trimmers on the side of the large three-gang tuning capacitor for maximum audio output. Now turn the bandswitch to the clockwise end of the 80-meter arc. Set the tuning dial at 3.8 mc, and adjust the signal generator around 3.8 mc for an audible beat note, reducing the generator output as required to keep the audio output below 0.5 volt. Adjust the front end center slugs of the three controlled by the bandswitch, for maximum audio output. A thin insulated screwdriver is required for this adjustment. The slug ends are slotted, and may be engaged through the coil mounting clip holes. After both slugs are peaked, check to see that receiver noise peaks up near the center of the 40- and 20-meter arcs.
8. FINAL ADJUSTMENT OF VFO. Adjust the receiver to 14.2 mc, and accurately set the signal generator to 14.2 mc. Adjust the VFO trimmer so that zero beat occurs at exactly 14.2 mc on the receiver dial. Check the lower edges of the other three bands. They should all be within 3 kc of correct dial setting. This completes the receiver function alignment.
9. PRELIMINARY BALANCED MODULATOR ALIGNMENT. Connect the VTVM to the collector of Q6. Turn the MIC. GAIN fully counterclockwise and press the microphone button. Adjust the carrier balance potentiometer and carrier balance trimmer alternately for minimum meter reading.
10. TRANSMITTER DRIVER ALIGNMENT. Connect a 50-ohm dummy load to the antenna terminals, and set the bandswitch to the center of the 15-meter arc. Turn the bias adjust potentiometer fully counter-clockwise. Connect the VTVM to the rear stator lug of the large three-gang variable capacitor. Apply a 20-microvolt, 400 cps audio signal to the microphone input jack .With the microphone button pressed, advance the MIC. GAIN control clockwise until a substantial reading is noted on the VTVM. Peak the rear trimmer on the side of the large variable capacitor for maximum meter reading. Now reduce the audio tone to zero: The meter reading should fall to almost zero. If it does not, the trimmer is probably tuned to the 24.6 mc injection frequency. Make certain that the trimmer is peaked on the 21 mc. sideband signal.

    Now turn the bandswitch to the clockwise edge of the 80-meter arc. With the audio tone applied, adjust the rear slug of the three connected to the bandswitch for maximum meter reading.
11. POWER AMPLIFIER ALIGNMENT. Turn the MIC. GAIN control fully counter-clockwise. Set the METER switch to PL. MA. X 100. Press the microphone button and gradually turn the bias adjust potentiometer clockwise until a reading of about 0.8 is indicated on the front-panel meter. Connect the VTVM across the antenna terminals and apply a two-tone test signal to the microphone jack. Turn up the MIC. GAIN control until some drive appears as evidenced by a rise in plate current. With a monitor scope (Heath Kit or equivalent) connected to the antenna connector, tune the PA TUNE and PA LOAD controls as required to obtain adequate drive. Repeak the rear slug of the three connected to the bandswitch for maximum drive. It should be possible to obtain at least 60 volts on the VTVM with no evidence of flat topping on the monitor scope.

    Now turn the bandswitch to the center of the 15 meter arc, and turn up the MIC. GAIN control to obtain some drive to the power amplifier. If any evidence of self-oscillation or instability is seen on the monitor scope, adjust the neutralizing capacitor as necessary to eliminate it. Peak the rear trimmer on the side of the large three-gang variable capacitor for maximum drive. Adjust the PA TUNE and PA LOAD controls for maximum output. It should be possible to obtain at least 50 volts on the VTVM with no evidence of flat-topping.

    Now carefully adjust the neutralizing capacitor until maximum output occurs at the same setting of the PA TUNE control as minimum plate current. This indicates proper neutralization. Finally, repeak the rear trimmer on the three-gang capacitor.

    Check to see that maximum drive on all bands occurs at the same bandswitch setting that produces maximum receiver noise. If a discrepancy is found on the 40 or 80 meter bands adjust the rear slug for the best compromise setting. If any discrepancy exists on the 20- and 15-meter bands, adjust the rear trimmer for the best compromise setting.
12. 24 MC TRAP COIL ADJUSTMENT. Set the transmitter controls for maximum output on 15 meters. Then turn the MIC. GAIN control fully counter-clockwise. Turn the PA TUNE control clockwise toward minimum capacity) until a small rise in VTVM reading is found. Now carefully adjust the slug of the 24 mc trap coil located between the two three-gang capacitors for minimum VTVM reading. The reading should dip to approximately 1.0 volt or less.
13. FINAL CARRIER BALANCE ADJUSTMENT. Return the PA TUNE capacitor to the setting that provides maximum 15-meter output with the MIC. GAIN advanced. Turn the MIC. GAIN control fully counter-clockwise, alternately adjust the carrier balance potentiometer and the carrier balance capacitor for minimum VTVM reading. Set the mode selector to the opposite sideband. The VTVM should read 0.15 volt or less on either sideband. This completes the transmit function alignment.



All Resistors ½ watt unless indicated.

Capacitors in decimals in microfarads, all others in micro micro farads, except as indicated

QUICK SERVICE VOLTAGE CHART (Refer to Top and Bottom View)

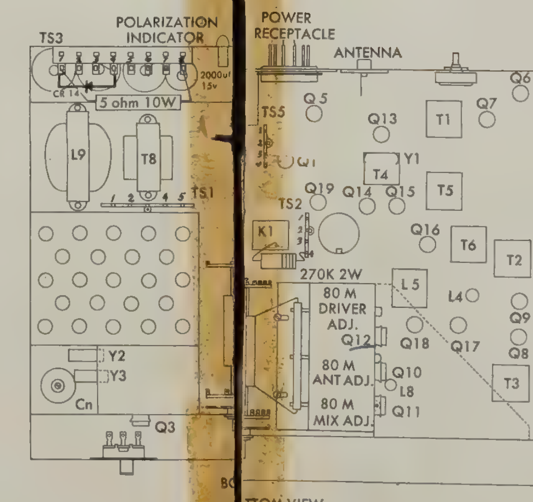
Terminal Number	Measure Between Pin and Pin		Receive	Transmit**	Function
TS2	3—	4+	420dc	380dc	High Voltage Supply
TS2	3—	4+	500dc*	420dc*	High Voltage Supply
TS3	1	Gnd	115ac	115ac	Supply
TS3	5	6	115ac	115ac	Input
TS5	3	Gnd	8.5 dc	8.5 dc	Reg. Trans. Supply
TS5	1	Gnd	—	9.5 dc	Transmit only
TS5	4	Gnd	10 dc	10 dc	Unreg. Trans. Supply
TS6	3	Gnd	280dc	240dc	High Voltage
TS6	8	Gnd	140dc	120dc	High Voltage

Above readings except * with Simpson 260, 20K ohms per volt
* Made with Hewlett-Packard HP-410B VTVM. If VTVM used do not allow ground, use isolation transformer.
** Tune Position.

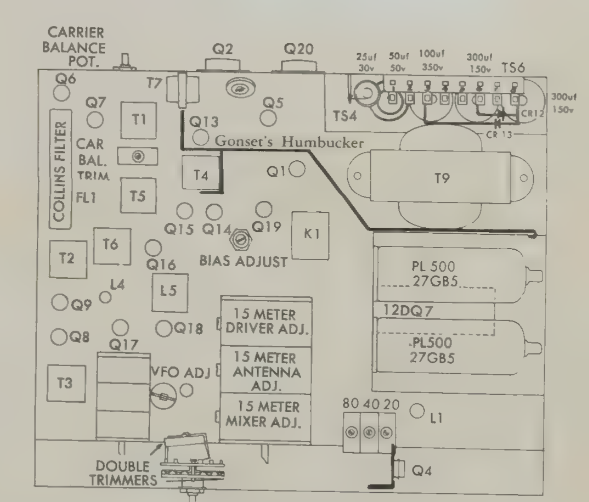
SEMICONDUCTOR CHARACTERISTICS AND VOLTAGE CHART

No.	Type	Mfr.	Desc.	Voltages Base	Emitter	Collector	Measured In
Q1	T2515	Philco	PNP Alloy	7.4	7.6	1.6	Receive
Q2	2N301	RCA	PNP Alloy	9.2	9.4	−6.0	Receive
Q3	2N1727	Philco	PNP MADT	8.0	8.2	0	Receive 80M
Q4	2N388	Philco	NPN Alloy	0.5	0.5	4.0	Transmit
Q5	T2515	Philco	PNP Alloy	7.3	7.5	2.5	Receive
Q6	2N1727	Philco	PNP MADT	9.2	9.4	0	Transmit
Q7	2N1727	Philco	PNP MADT	8.5*	8.7*	0	Receive
Q8	2N1727	Philco	PNP MADT	8.6	8.8	0	Transmit
Q9	2N1727	Philco	PNP MADT	8.4	8.6	0	Receive
Q10 **	2N1867	Philco	MADT Vbe-2V	8.7	8.8	0	Transmit
Q11	2N1867	Philco	MADT Vbe-2V	9.2*	9.3*	0	Receive
Q12	2N1727	Philco	PNP MADT	8.7	8.8	0	Receive
Q13	T2515	Philco	PNP Alloy	4.0	4.3	0	
Q14	T2515	Philco	PNP Alloy	7.2	5.6	0	
Q15	T2515	Philco	PNP Alloy	9.0	7.5	0	
Q16	T2515	Philco	PNP Alloy	9.8	9.5	0	
Q17	2N1744	Philco	PNP MADT	8.8	9.0	0	
Q18	2N1744	Philco	PNP MADT	8.8	9.0	4.3	
Q19	T6126	Philco	NPN Alloy	0.4	0	9.0	
Q20	2N301	RCA	PNP Alloy	-0.2	0	−7.0	

*Voltage varies with volume control setting. Measurement made fully clockwise. ** 2N1866 or 2N2402 alternate



BOTTOM VIEW



TOP VIEW

TUBE VOLTAGES

Tube	PIN	1	2	3	4	5	6	7	8	9	Cap
V1		6.2	0	6.2	See note			460	200	6.2	—
V2/V3		−27	−27	0	See note		150	8	0	—	460

1. Tube voltages are measured from Pin 3 of V2 with microphone button pressed.
2. Test pins 4, 5, 6 of V1 and Pins 4, 5 of V2/V3 by inspecting to see that tube heaters are lit.

DIODE TYPES

Diode	Type	Mfr.	Desc.
CR1-4	S262	Amperex	Point Germanium
CR5	1N87	Amperex	Point Germanium
CR6-7	S262	Amperex	Point Germanium
CR8-13	HC-70	Solitron	Power Silicon
CR14	1N581	Semtech	Zener, 10 volt
CR15	1N456		Germanium
CR16	S262	Amperex	Point Germanium

position, operation is USB, and a measured amount of carrier signal is inserted in the d-c load resistor of CR5, for tuneup.

The 2282.25 kc upper or lower sideband output from T2 is applied to the bilateral VFO Mixer, Q8 and Q9. Also applied to this mixer is an injection signal between 5507.25 kc and 5707.25 kc. The frequency of this injection is controlled by the main tuning knob, and determines the final output frequency within the selected band. This frequency is generated by the VFO, Q18, and amplified by VFO Buffer Q17. Buffer coil L4 broadly tunes the buffer to provide constant output across the VFO range.

Tunable i-f transformer T3, connected to the output of VFO Mixer Q8 and Q9, tunes the frequency range 3225 kc through 3425 kc. This frequency range is the result of mixing the incoming 2282.25 kc sideband signal with the VFO injection frequency, and can be either upper or lower sideband, depending on the mode selected. Transformer T3 is gang-tuned with the VFO, and thus is always accurately tuned to the desired frequency.

The 3225 kc to 3425 kc sideband signal output from VFO Mixer Q8 and Q9 is applied to the bilateral High Frequency Mixer, Q10 and Q11. Also applied to this mixer is an injection frequency from the High Frequency Crystal Oscillator, Q3. On 80 meters, this oscillator produces output at 7225 kc, controlled by crystal Y2. On 40, 20, and 15 meters, Q3 is connected as an overtone oscillator, with the overtone frequency being determined by the resonant frequency of L1 and the trimmer capacitor switched in by the bandswitch. Crystal Y3, with a fundamental frequency of 3525 kc, operates on its third overtone on 40 meters, (10,575 kc), on its fifth overtone on 20 meters, (17,625 kc) and on its seventh overtone on 15 meters, (24,675 kc). The 3225 to 3425 kc single sideband signal is subtractively mixed with the injection frequency on all bands, resulting in consistent dial readings and sideband selection. The output of High Frequency Mixer Q10 and passed through transformer T7 to Audio Power Amplifier Q2, and then to the speaker through T8.

The VOLUME (RF gain) control sets the gain, on receive only, of the bilateral High Frequency Mixer and 456 KC Amplifier. VFO Mixer Q8 and Q9, and the audio stages, operate at full gain at all times.

POWER SUPPLY

High voltage of approximately 480 volts is furnished to the transmitter driver and power amplifier stages by a voltage tripler, CR-11, CR-12, and CR-13, operating directly from the incoming 117-volt a-c line. Since all parts of the driver and power amplifier stages are electrically isolated from the chassis, no shock hazard exists. However, due to the voltage gradient existing between the voltage tripler and chassis ground, it is necessary to properly polarize the power plug. A neon lamp facilitates proper connection of the plug to the a-c power outlet. As explained in the Installation section, the neon light must be out to indicate proper polarization.

A two-winding transformer supplies the remaining voltages required by the transceiver. One winding operates the series-connected heaters of the driver and power amplifier stages, and in addition is full-wave rectified by diodes CR-8 and CR-9. The filtered output of this winding is approximately 15 volts, and supplies power for the Audio Output Amplifier Q2. In addition, this voltage is series regulated by Q20 and zener diode CR-14 to provide regulated 10-volt output to all other transistor stages except Q1, Q4, Q5, and Q13, which require additional filtering. The voltage for these stages is smoothed by a resistor-capacitor filter operating from the 10-volt bus, and is 9.5 volts.

Bias for the transmitter power amplifier is obtained from the second winding of the transformer, and is rectified by CR-10. The actual value of bias voltage is determined by the bias-adjust potentiometer.

TROUBLESHOOTING

The SB-33 transceiver has been carefully aligned and tested at the factory, and all adjustments that might become misaligned from the effects of vibration and temperature cycling have been securely locked in place.

Problems that might possibly arise, and their detection and correction, are included in the following paragraphs.

CARRIER BALANCE

The SB-33 transceiver is designed to maintain carrier suppression of at least 50 db below full output for extended periods of time. If for any reason excessive carrier is present, the carrier balance potentiometer on the rear panel should be readjusted. The most accurate method for doing this requires a fairly sensitive vacuum-tube r-f voltmeter, such as the Hewlett-Packard HP-410B, or equivalent, connected across the antenna terminals. With the MIC. GAIN control set fully counter-clockwise, and the microphone button pressed, the residual carrier, as measured by the voltmeter, should be nulled to a value of 0.2 volts rms, or less, by use of the carrier balance potentiometer. Check operation on both sidebands since there may be a slight variation in carrier between the two modes. Any variation should be averaged out by the potentiometer. If it is not possible to reduce the carrier to a reading of 0.2 volts with the potentiometer alone, remove the set from the cabinet, and readjust the carrier balance capacitor located on the chassis top near the rear left corner of the chassis. This capacitor and the potentiometer interact somewhat so that several cycles of adjustment may be required.

LOW TRANSMITTER OUTPUT

Loss of transmitter output generally indicates weak tubes. If the off-resonance plate current of the power amplifier stage becomes somewhat less than 250 ma, as indicated on the front panel meter, either the driver or power amplifier tubes may require replacement. If the power amplifier tubes are replaced, reneutralization may be required. The neutralizing capacitor is located just to the right of the speaker, and must be adjusted with an insulated alignment tool from the bottom side of the chassis. Proper neutralization is indicated when maximum output and minimum plate current occur with the same setting of the PA TUNE control. This adjustment should be made with the set tuned for 15-meter operation.

LOW RECEIVER SENSITIVITY

Since the receive portion of the transceiver is fully transistorized, no loss in sensitivity should be experienced with age. If the receiver seems to be lacking in sensitivity, the following transformers may be peaked up on noise without interfering with the transmit function:

- T1 Single Slug (May affect carrier balance on transmit. Re-balance carrier).
- T2 Top and Bottom slugs..
- T3 Align with set tuned to 3.9 mc. Adjust 2 slugs.

Low audio output or distortion may also be traced to leaky or shorted electrolytic capacitors in the audio portions of the receiver or transmitter. These will usually cause abnormal voltage readings at the various stages. Refer to the voltage chart on the reverse side.

REMOVAL AND REPLACEMENT OF GONSET'S HUMBUCKER

Gonset's Humbucker, (patent applied for) is shown in the equipment top view on the reverse side. This device cancels out the interaction of the power supply and audio stages, and effectively eliminates any source of 60 cycle hum from the unit. It may be easily removed to allow servicing of the equipment, and slips readily back into place when service is complete.

SBE SIDEBAND ENGINEERS, INC.
RANCHO SANTA FE, CALIFORNIA

OPERATION and SERVICE

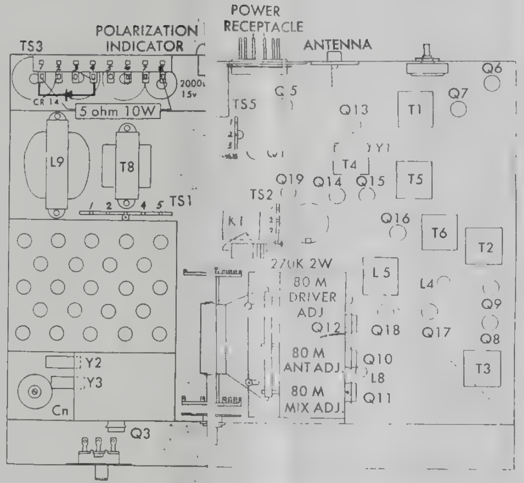
SB 33

SINGLE SIDEBAND TRANSCEIVER

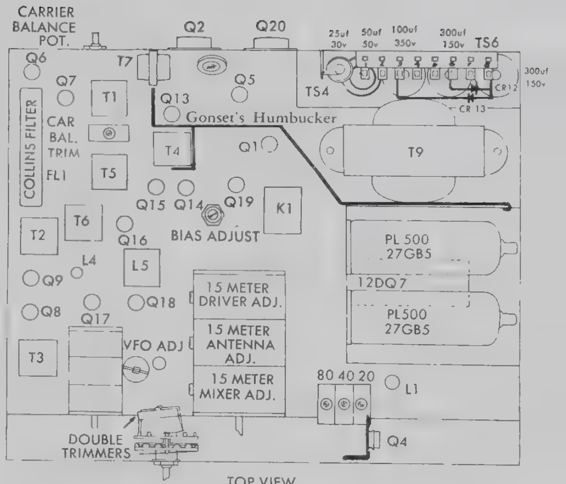
SEMICONDUCTOR CHARACTERISTICS AND VOLTAGE CHART

No.	Type	Mfr.	Desc.	Voltages Base	Emitter	Collector	Measured in
Q1	T2515	Philco	PNP Alloy	7.4	7.6	1.6	Receive
Q2	2N301	RCA	PNP Alloy	9.2	9.4	−6.0	Receive
Q3	2N1727	Philco	PNP MADT	8.0	8.2	0	Receive 80M
Q4	2N388	Philco	NPN Alloy	0.5	0.5	4.0	Transmit
Q5	T2515	Philco	PNP Alloy	7.3	7.5	2.5	Receive
Q6	2N1727	Philco	PNP MADT	9.2	9.4	0	Transmit
Q7	2N1727	Philco	PNP MADT	8.5*	8.7*	0	Receive
Q8	2N1727	Philco	PNP MADT	8.6	8.8	0	Transmit
Q9	2N1727	Philco	PNP MADT	8.4	8.6	0	Receive
Q10 **	2N1867	Philco	MADT Vbe-2V	8.7	8.8	0	Transmit
Q11	2N1867	Philco	MADT Vbe-2V	9.2*	9.3*	0	Receive
Q12	2N1727	Philco	PNP MADT	8.7	8.8	0	Receive
Q13	T2515	Philco	PNP Alloy	4.0	4.3	0	
Q14	T2515	Philco	PNP Alloy	7.2	5.6	0	
Q15	T2515	Philco	PNP Alloy	9.0	7.5	0	
Q16	T2515	Philco	PNP Alloy	9.8	9.5	0	
Q17	2N1744	Philco	PNP MADT	8.8	9.0	0	
Q18	2N1744	Philco	PNP MADT	8.8	9.0	4.3	
Q19	T6126	Philco	NPN Alloy	0.4	0	9.0	
Q20	2N301	RCA	PNP Alloy	-0.2	0	−7.0	

*Voltage varies with volume control setting. Measurement made fully clockwise. ** 2N1866 or 2N2402 alternate



BOTTOM VIEW



TOP VIEW

TUBE VOLTAGES

Tube	PIN 1	2	3	4	5	6	7	8	9	Cap
V1	6.2	0	6.2	See note			460	200	6.2	-
V2/V3	−27	−27	0	See note		150	8	0	—	460

1. Tube voltages are measured from Pin 3 of V2 with microphone button pressed.
2. Test pins 4, 5, 6 of V1 and Pins 4, 5 of V2/V3 by inspecting to see that tube heaters are lit.

DIODE TYPES

Diode	Type	Mfr.	Desc.
CR1-4	S262	Amperex	Point Germanium
CR5	1N87	Amperex	Point Germanium
CR6-7	S262	Amperex	Point Germanium
CR8-13	HC-70	Solitron	Power Silicon
CR14	1N581	Semtech	Zener, 10 volt
CR15	1N456		Germanium
CR16	S262	Amperex	Point Germanium

THEORY OF OPERATION

The SB-33 single sideband transceiver is essentially bilateral. With the exception of the receiver RF Amplifier and the high-level transmitting stages, the signal stages may amplify in either direction. During the receive function they amplify in one direction, on transmit they amplify in the opposite direction. The same tuned circuits are used for both transmitting or receiving. The various injection oscillators operate continuously, supplying the local oscillator signals to the proper mixer stages.

All transistors in the transceiver operate in the common emitter configuration, with the exception of the Receiver RF Amplifier, Q12. This stage operates common base. (See Schematic on reverse side).

A typical bilateral amplifier stage may be understood by referring to the 456 KC Amplifier, Q6 and Q7, in the schematic diagram. With relay K1 de-energized, or in receive position, the 33K base bias resistor of Q6 is returned through the relay contacts to the 10-volt bus. Since the emitter of Q6 is also connected to 10 volts, no base current flows, and the transistor remains cut off. The 18 K base bias resistor of Q7 is returned through the volume control and relay contacts to ground. With the volume control advanced, Q7 conducts and amplifies any signal appearing on its base. Thus, with the relay de-energized, this stage will amplify a signal appearing at the mechanical filter, FL-1, and the amplified output will be impressed on the i-f transformer T1. With the relay energized, or in transmit position, the reverse occurs, and Q6 conducts while Q7 is cut off. A signal appearing at T1 will be amplified and fed to filter FL-1. Similarly, the amplifying direction of the VFO Mixer, Q8 and Q9, and the High Frequency Mixer Q10 and Q11, is controlled by the relay. Unilateral stages that are required to operate only on receive or transmit are turned off when not in use by returning their base bias resistors to the appropriate relay contact. The transmitter tubes are disabled during receive by opening their cathode leads.

TRANSMIT FUNCTION

An audio signal from the microphone, controlled in amplitude by the MIC. GAIN control, is amplified by the Microphone Amplifier, Q4, and applied to the base of the Signal Splitter, Q5, which acts as an emitter follower. The low-impedance output from Q5 drives a ring balanced modulator, CR1-4. Crystal Oscillator, Q14, operating at 456.45 kc, provides a carrier to the balanced modulator through Emitter Follower, Q13. Carrier balance is obtained by a potentiometer and a trimmer capacitor. Double sideband, suppressed carrier output from the balanced modulator is amplified through T1 by the bilateral 456 KC Amplifier, Q6 and Q7. The amplified signal is then passed through Mechanical Filter FL-1 which suppresses the upper sideband.

Output from Crystal Oscillator, Q14, is also applied to Frequency Doubler Q15. The doubled frequency from Q15 is then either doubled again or tripledby Q16. With the mode selector switch set to LSB, the frequency is doubled, with the switch on USB, it is tripled. Thus, on LSB a 1825.8 kc (456.45 X 4) signal appears on lug E of T6. On USB, a 2738.7 kc (456.45 X 6) output appears.

Doubler/tripler transformer T6 is connected in a ring with filter FL-1, Sideband Selector Mixer CR5, and transformer T2, which is tuned to 2282.25 kc, to form a ring mixer. With the mode selector on LSB, 1825.8 kc output from T6 is additively mixed with the filter output, 456.45 kc, to produce a 2282.25 kc lower sideband signal at T2. With the mode selector set on USB, the 2738.7 kc output from T6 is subtractively mixed with the filter output to produce a 2282.25 kc upper sideband signal at T2. Thus, the mode selector determines the mode of the sideband signal by setting the Doubler/Tripler, Q16, to either double or triple the second harmonic of the carrier oscil-

Q11, the final output frequency, appears across coil L2. The resonant frequency of L2 is controlled both by a large variable capacitor and a special slug which penetrates the coil by an amount dependent upon the setting of the bandswitch. The large variable capacitor is mechanically linked to the bandswitch through a Geneva movement (Patent Applied for) so that rotating the variable capacitor shaft tunes the coil through a limited range, bracketing the given operating band, then changes the bandswitch to the next band, tuning a limited range bracketing this band, etc. On 80 meters the slug is almost fully penetrated into the coil, and the variable capacitor is near maximum capacity. On 40 and 20 meters, the slug and capacitor are at near mid-range, and on 15 meters, the slug is fully withdrawn from the coil and the capacitor is near minimum. In this unique method of tuning and bandswitching, the Q and inductance/capacitance ratio of L2 and the variable capacitor are near optimum on all bands, and the resonant impedance remains essentially constant across the tuning range. This tuning is linked with, and duplicated in, antenna coil L3 and driver coil L6, to result in exciter train tuning with only one control.

The single sideband, suppressed carrier final output signal from L2 is applied to the grid of Transmitter Driver V1, where it is amplified, and appears across L6. A low-impedance winding on L6 couples the signal to the parallel grids of Power Amplifiers V2 and V3. Neutralization of the power amplifiers is accomplished by feeding back a small amount of the output through Cn to the top of L6, with the low impedance winding providing the necessary phase reversal.

Final output from V2 and V3 is fed to a pi-section network consisting of L7 and the PA TUNE and PA LOAD capacitors. A section of the bandswitch adjusts the inductance of L7 to the correct value for each band, and also adds fixed amounts of capacity to both the PA LOAD and PA TUNE capacitors on 80 meters.

RECEIVE FUNCTION

With relay K1 de-energized, a signal from the antenna is coupled through a low-impedance tap to antenna coil L3. Diode CR6 is essentially paralleled across the coil and conducts only when extremely strong signals are present, thus protecting the Receiver RF Amplifier Q12 from the possibility of burning out. On transmit, diode CR6 is forward biased, effectively shorting L3 at all times.

The signal at L3 is coupled to the emitter of Receiver RF Amplifier Q12, which operates as a common-base amplifier. The gain of the stage is controlled by AGC Amplifier Q19. A measured amount of the audio output signal is rectified by Q19 and used to bias the emitter of Q12 toward cutoff. Q12 operates at full gain on very weak signals, but cuts off in the presence of even a moderate signal, thus protecting the following stages from overload.

The amplified signal from Q12 is applied to bilateral High Frequency Mixer Q10 and Q11. With injection from Q3, this stage converts the signal to a frequency within the range 3225 to 3425 kc. The converted signal is then mixed by Q8 and Q9 to 2282.25 kc with injection received from VFO Q18 and VFO Buffer Q17.

Output from VFO Mixer Q8 and Q9 is converted by diode CR5 to the 456.45 kc reference frequency in a manner exactly opposite to that described for this stage during the transmit function. The filter output from FL-1 is then amplified by Q6 and Q7 and coupled through T1 to the ring modulator, CR1-4.

With BFO injection from the carrier oscillator, the ring modulator now functions as a detector, and produces an audio output which is applied to the emitter of Signal Splitter Q5. On receive, Q5 operates as a common-base amplifier, with output taken from the collector and ap-

SEMICONDUCTOR CHARACTERISTICS AND VOLTAGE CHART

No.	Type	Mfr.	Desc.	Voltages Base	Emitter	Collector	Measured In
Q1	T2515	Philco	PNP Alloy	7.4	7.6	1.6	Receive
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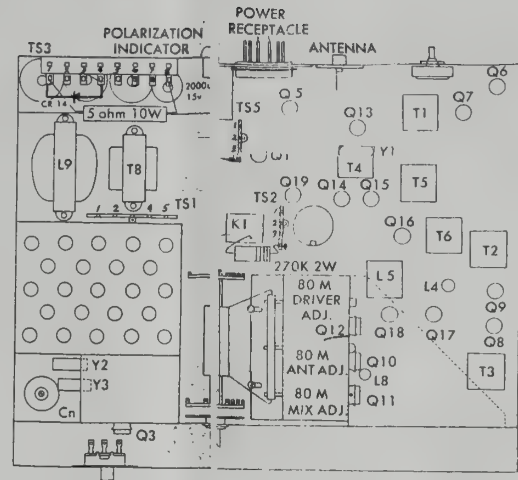
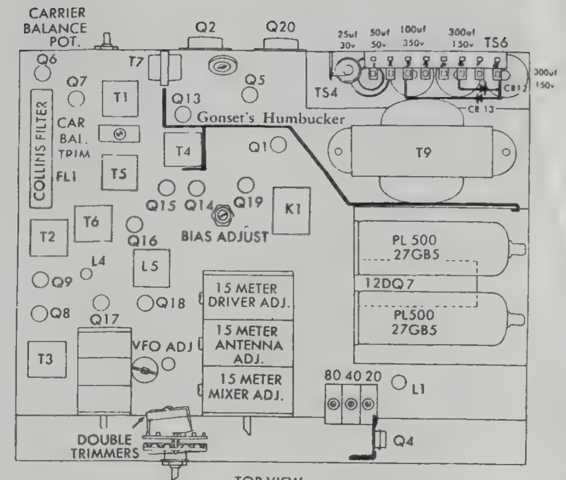
Q3	2N1727	Philco	PNP MADT	8.0	8.2	0	Receive 80M
Q4	2N388	Philco	NPN Alloy	0.5	0.5	4.0	Transmit
Q5	T2515	Philco	PNP Alloy	7.3	7.5	2.5	Receive
Q6	2N1727	Philco	PNP MADT	9.2	9.4	0	Transmit
Q7	2N1727	Philco	PNP MADT	8.5*	8.7*	0	Receive
Q8	2N1727	Philco	PNP MADT	8.6	8.8	0	Transmit
Q9	2N1727	Philco	PNP MADT	8.4	8.6	0	Receive
Q10 **	2N1867	Philco	MADT Vbe-2V	8.7	8.8	0	Transmit
Q11	2N1867	Philco	MADT Vbe-2V	9.2*	9.3*	0	Receive
Q12	2N1727	Philco	PNP MADT	8.7	8.8	0	Receive
Q13	T2515	Philco	PNP Alloy	4.0	4.3	0	
Q14	T2515	Philco	PNP Alloy	7.2	5.6	0	
Q15	T2515	Philco	PNP Alloy	9.0	7.5	0	
Q16	T2515	Philco	PNP Alloy	9.8	9.5	0	
Q17	2N1744	Philco	PNP MADT	8.8	9.0	0	
Q18	2N1744	Philco	PNP MADT	8.8	9.0	4.3	
Q19	T6126	Philco	NPN Alloy	0.4	0	9.0	
Q20	2N301	RCA	PNP Alloy	−0.2	0	−7.0	

*Voltage varies with volume control setting. Measurement made fully clockwise. ** 2N1866 or 2N2402 alternate



BOTTOM VIEW



TOP VIEW

TUBE VOLTAGES

Tube	PIN	1	2	3	4	5	6	7	8	9	Cap
V1		6.2	0	6.2	See note			460	200	6.2	—
V2/V3		−27	−27	0	See note		150	8	0	--	460

1. Tube voltages are measured from Pin 3 of V2 with microphone button pressed.
2. Test pins 4, 5, 6 of V1 and Pins 4, 5 of V2/V3 by inspecting to see that tube heaters are lit.

DIODE TYPES

Diode	Type	Mfr.	Desc.
CR1-4	S262	Amperex	Point Germanium
CR5	1N87	Amperex	Point Germanium
CR6-7	S262	Amperex	Point Germanium
CR8-13	HC-70	Solitron	Power Silicon
CR14	1N581	Semtech	Zener, 10 volt
CR15	1N456		Germanium
CR16	S262	Amperex	Point Germanium

THEORY OF OPERATION

The SB-33 single sideband transceiver is essentially bilateral. With the exception of the receiver RF Amplifier and the high-level transmitting stages, the signal stages may amplify in either direction. During the receive function they amplify in one direction, on transmit they amplify in the opposite direction. The same tuned circuits are used for both transmitting or receiving. The various injection oscillators operate continuously, supplying the local oscillator signals to the proper mixer stages.

All transistors in the transceiver operate in the common emitter configuration, with the exception of the Receiver RF Amplifier, Q12. This stage operates common base. (See Schematic on reverse side).

A typical bilateral amplifier stage may be understood by referring to the 456 KC Amplifier, Q6 and Q7, in the schematic diagram. With relay K1 de-energized, or in receive position, the 33K base bias resistor of Q6 is returned through the relay contacts to the 10-volt bus. Since the emitter of Q6 is also connected to 10 volts, no base current flows, and the transistor remains cut off. The 18 K base bias resistor of Q7 is returned through the volume control and relay contacts to ground. With the volume control advanced, Q7 conducts and amplifies any signal appearing on its base. Thus, with the relay de-energized, this stage will amplify a signal appearing at the mechanical filter, FL-1, and the amplified output will be impressed on the i-f transformer T1. With the relay energized, or in transmit position, the reverse occurs, and Q6 conducts while Q7 is cut off. A signal appearing at T1 will be amplified and fed to filter FL-1. Similarly, the amplifying direction of the VFO Mixer, Q8 and Q9, and the High Frequency Mixer, Q10 and Q11, is controlled by the relay. Unilateral stages that are required to operate only on receive or transmit are turned off when not in use by returning their base bias resistors to the appropriate relay contact. The transmitter tubes are disabled during receive by opening their cathode leads.

TRANSMIT FUNCTION

An audio signal from the microphone, controlled in amplitude by the MIC. GAIN control, is amplified by the Microphone Amplifier, Q4, and applied to the base of the Signal Splitter, Q5, which acts as an emitter follower. The low-impedance output from Q5 drives a ring balanced modulator, CR1-4. Crystal Oscillator, Q14, operating at 456.45 kc, provides a carrier to the balanced modulator through Emitter Follower, Q13. Carrier balance is obtained by a potentiometer and a trimmer capacitor. Double sideband, suppressed carrier output from the balanced modulator is amplified through T1 by the bilateral 456 KC Amplifier, Q6 and Q7. The amplified signal is then passed through Mechanical Filter FL-1 which suppresses the upper sideband.

Output from Crystal Oscillator, Q14, is also applied to Frequency Doubler Q15. The doubled frequency from Q15 is then either doubled again or tripledby Q16. With the mode selector switch set to LSB, the frequency is doubled, with the switch on USB, it is tripled. Thus, on LSB a 1825.8 kc (456.45 X 4) signal appears on lug E of T6. On USB, a 2738.7 kc (456.45 X 6) output appears.

Doubler/tripler transformer T6 is connected in a ring with filter FL-1, Sideband Selector Mixer CR5, and transformer T2, which is tuned to 2282.25 kc, to form a ring mixer. With the mode selector on LSB, 1825.8 kc output from T6 is additively mixed with the filter output, 456.45 kc, to produce a 2282.25 kc lower sideband signal at T2. With the mode selector set on USB, the 2738.7 kc output from T6 is subtractively mixed with the filter output to produce a 2282.25 kc upper sideband signal at T2. Thus, the mode selector determines the mode of the sideband signal by setting the Doubler/Tripler, Q16, to either double or triple the second harmonic of the carrier oscil-

Q11, the final output frequency, appears across coil L2. The resonant frequency of L2 is controlled both by a large variable capacitor and a special slug which penetrates the coil by an amount dependent upon the setting of the bandswitch. The large variable capacitor is mechanically linked to the bandswitch through a Geneva movement (Patent Applied for) so that rotating the variable capacitor shaft tunes the coil through a limited range, bracketing the given operating band, then changes the bandswitch to the next band, tuning a limited range bracketing this band, etc. On 80 meters the slug is almost fully penetrated into the coil, and the variable capacitor is near maximum capacity. On 40 and 20 meters, the slug and capacitor are at near mid-range, and on 15 meters, the slug is fully withdrawn from the coil and the capacitor is near minimum. In this unique method of tuning and bandswitching, the Q and inductance/capacitance ratio of L2 and the variable capacitor are near optimum on all bands, and the resonant impedance remains essentially constant across the tuning range. This tuning is linked with, and duplicated in, antenna coil L3 and driver coil L6, to result in exciter train tuning with only one control.

The single sideband, suppressed carrier final output signal from L2 is applied to the grid of Transmitter Driver V1, where it is amplified, and appears across L6. A low-impedance winding on L6 couples the signal to the parallel grids of Power Amplifiers V2 and V3. Neutralization of the power amplifiers is accomplished by feeding back a small amount of the output through Cn to the top of L6, with the low impedance winding providing the necessary phase reversal.

Final output from V2 and V3 is fed to a pi-section network consisting of L7 and the PA TUNE and PA LOAD capacitors. A section of the bandswitch adjusts the inductance of L7 to the correct value for each band, and also adds fixed amounts of capacity to both the PA LOAD and PA TUNE capacitors on 80 meters.

RECEIVE FUNCTION

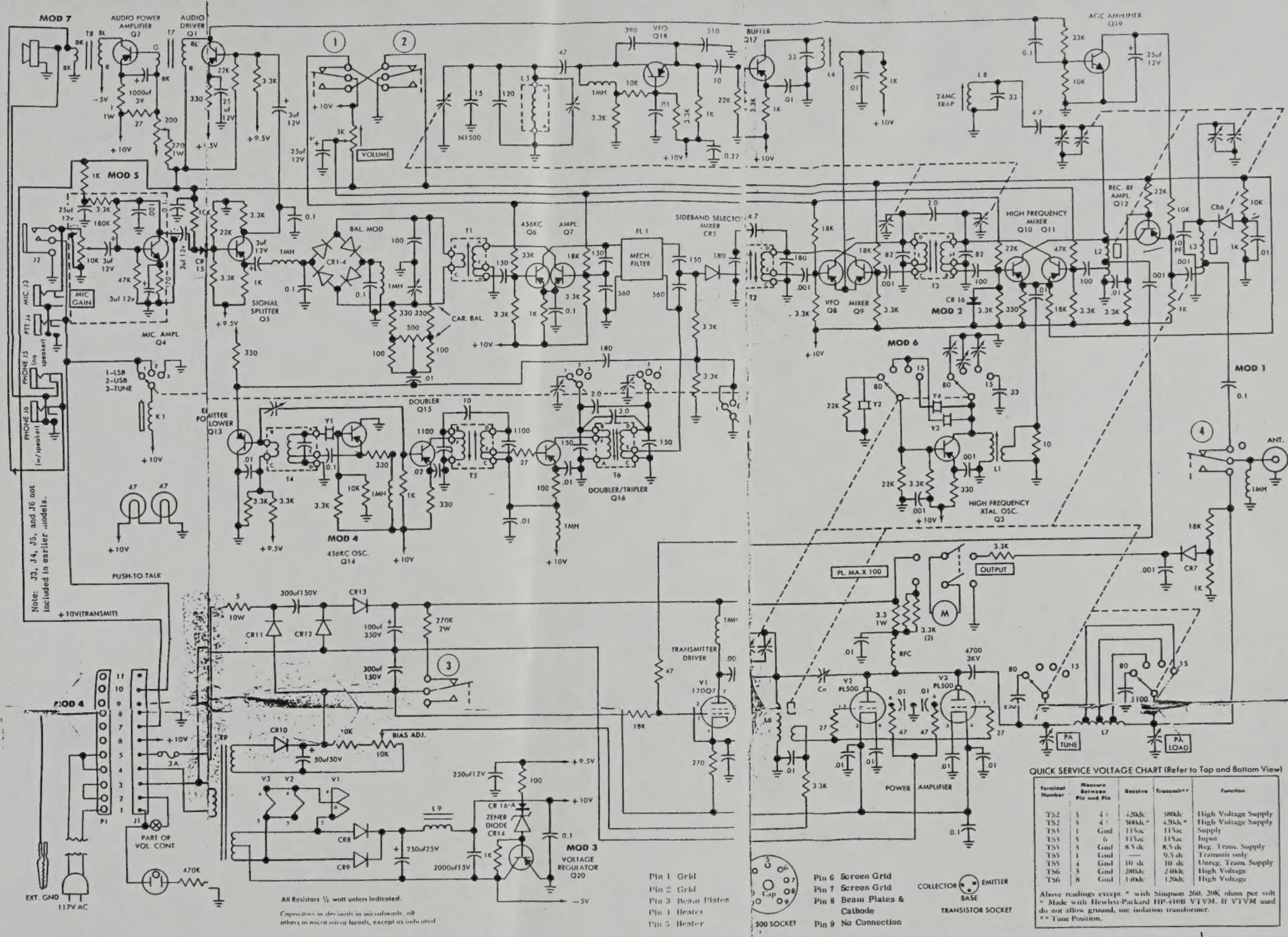
With relay K1 de-energized, a signal from the antenna is coupled through a low-impedance tap to antenna coil L3. Diode CR6 is essentially paralleled across the coil and conducts only when extremely strong signals are present, thus protecting the Receiver RF Amplifier Q12 from the possibility of burning out. On transmit, diode CR6 is forward biased, effectively shorting L3 at all times.

The signal at L3 is coupled to the emitter of Receiver RF Amplifier Q12, which operates as a common-base amplifier. The gain of the stage is controlled by AGC Amplifier Q19. A measured amount of the audio output signal is rectified by Q19 and used to bias the emitter of Q12 toward cutoff. Q12 operates at full gain on very weak signals, but cuts off in the presence of even a moderate signal, thus protecting the following stages from overload.

The amplified signal from Q12 is applied to bilateral High Frequency Mixer Q10 and Q11. With injection from Q3, this stage converts the signal to a frequency within the range 3225 to 3425 kc. The converted signal is then mixed by Q8 and Q9 to 2282.25 kc with injection received from VFO Q18 and VFO Buffer Q17.

Output from VFO Mixer Q8 and Q9 is converted by diode CR5 to the 456.45 kc reference frequency in a manner exactly opposite to that described for this stage during the transmit function. The filter output from FL-1 is then amplified by Q6 and Q7 and coupled through T1 to the ring modulator, CR1-4.

With BFO injection from the carrier oscillator, the ring modulator now functions as a detector, and produces an audio output which is applied to the emitter of Signal Splitter Q5. On receive, Q5 operates as a common-base amplifier, with output taken from the collector and ap-



QUICK SERVICE VOLTAGE CHART (Refer to Top and Bottom View)

Terminal Number	Measure Between Pin and Pin		Receive	Transmit**	Function
TS2	3	4	420dc	500dc	High Voltage Supply
TS2	3	4	500dc*	420dc*	High Voltage Supply
TS5	1	Gnd	115ac	115ac	Supply
TS4	5	6	115ac	115ac	Input
TS5	5	Gnd	8.5 dc	8.5 dc	Reg. Trans. Supply
TS5	1	Gnd	—	9.5 dc	Transmit only
TS5	4	Gnd	10 dc	10 dc	Unreg. Trans. Supply
TS6	3	Gnd	200dc	240dc	High Voltage
TS6	8	Gnd	140dc	120dc	High Voltage

Above readings except * with Simpson 260, 20K ohms per volt
* Made with Hewlett-Packard HP-410B VTVM. If VTVM used do not allow ground, use isolation transformer.
** Tune Position.